Forest Insect and Disease Conditions in the United States 1974

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Forest Service
U.S.Department
of Agriculture

FOREWORD

This annual report on forest insect and disease conditions is compiled in the Washington Office, Forest Insect and Disease Management Staff, State and Private Forestry, and is made possible through the contributions of professional forest entomologists and pathologists throughout the country. The report presents the reader with a brief description of the status of forest insect and disease outbreaks on lands of all ownerships. Its objectives are to provide continuity, from one year to the next, about the trends of forest insect and disease outbreaks, and to present pertinent evaluations closely aligned with the insect and disease conditions.

A substantial portion of the information comes to the entomologist and pathologist through a variety of sources—the interested camper, tourist, permittee, etc., and a broad-based net of professional foresters and land managers. These sources provide an ongoing surveillance system, which is essential in the early detection of outbreaks. Most of the information reported is accumulated through systematic aerial and ground surveys designed to either detect outbreaks or to provide data for evaluating the biological potential of an outbreak. Detailed information on insect or disease trends is determined by indepth evaluations of the critical life stages of the pest, its natural enemies, and the host.

Early detection and evaluation of outbreaks of insect infestation and disease infection have become increasingly important components of forest management, because they provide an opportunity to reduce the Nation's annual forest resource losses, estimated at 9 billion board feet annually, caused by insects and diseases. Furthermore, accurate and useful detection and evaluation data are absolutely essential in assisting the land manager to make important management decisions affecting forest resources. The critical nature of these decisions is emphasized when pesticides become necessary to control outbreaks.

The importance of detection and evaluation data has been emphasized with the tremendous infestations of the spruce budworm, gypsy moth, southern pine bettle, and mountain pine beetle. Control decisions are agonizingly difficult to make because of economic and environmental consideration, but the burden of these decisions can be eased by providing the needed detection and evaluation information to the decisionmaker.

Additional details on the insect or disease situations mentioned in this publication can be provided by contacting the regional authors directly.

Special thanks to pathologist Michael Srago, Region 5, San Francisco, Calif., and to entomologist Arthur R. Hastings, Northeastern Area, State and Private Forestry, St. Paul Field Office, for their assistance in compiling this report.

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This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

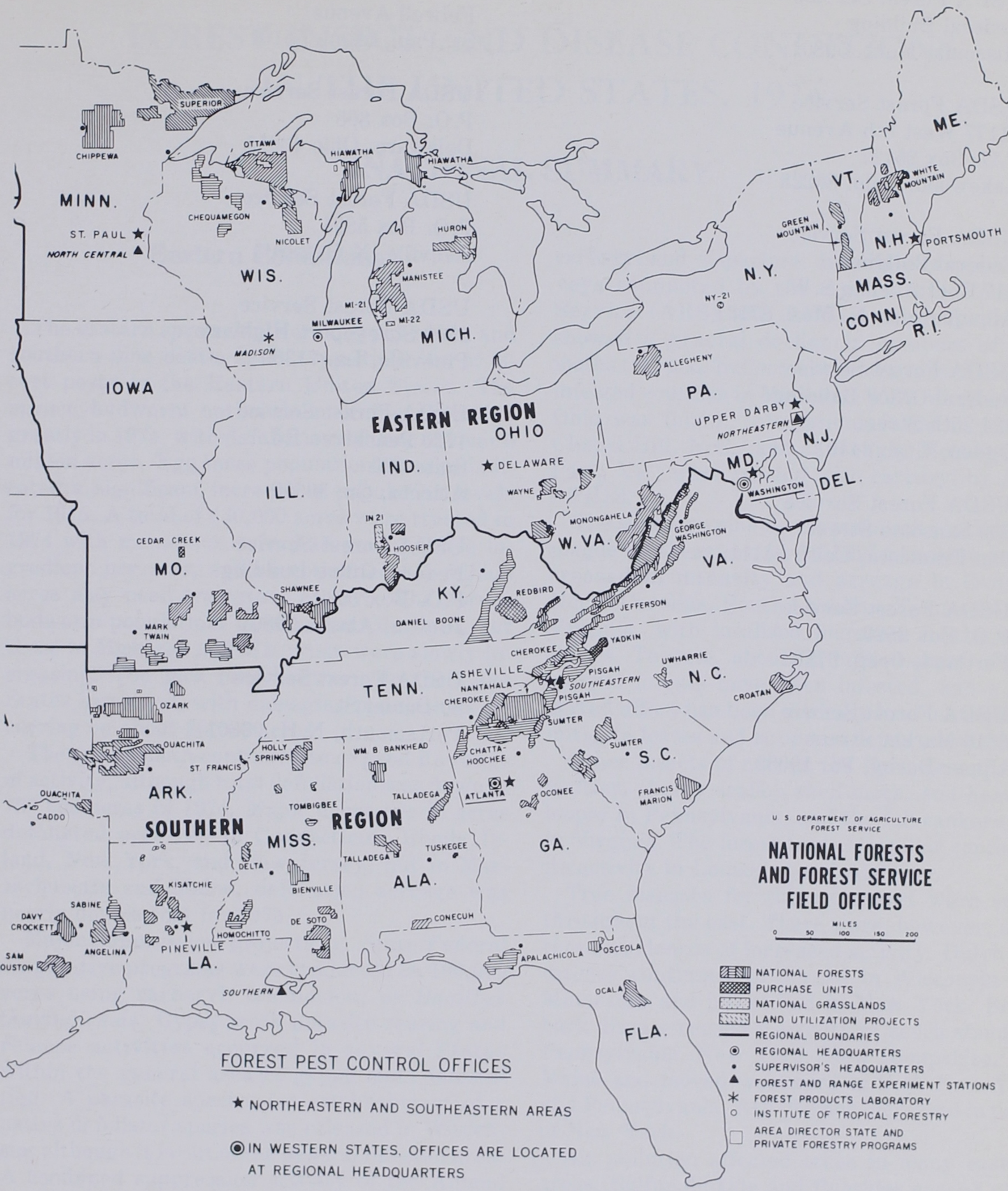
CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others which may be suitable.

Issued March 1977

THE NATIONAL

FOREST SYSTEM



FOREST PEST CONTROL OFFICES

★ NORTHEASTERN AND SOUTHEASTERN AREAS

◉ IN WESTERN STATES, OFFICES ARE LOCATED AT REGIONAL HEADQUARTERS

U S DEPARTMENT OF AGRICULTURE
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- □ AREA DIRECTOR STATE AND PRIVATE FORESTRY PROGRAMS

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FOREST INSECT AND DISEASE CONDITIONS IN THE UNITED STATES, 1974

NATIONAL SUMMARY

Eastern Conditions

The eastern spruce budworm, gypsy moth, and southern pine beetle again topped the list of insect pests in the Eastern United States. The spruce budworm outbreak in Maine expanded greatly in 1974, with defoliation evident on over 5 million acres. Egg mass population surveys indicated a significant increase in population levels for 1975. A total of 430,000 acres were treated in 1974 with mexacarbate at 0.15 pound active ingredient per acre, and an estimated 3.5 million acres may need treatment in 1975. The spruce budworm populations in Minnesota declined, but those in Michigan and Wisconsin were slowly increasing. The jack pine budworm in the Lake States increased, with damaging populations occurring on about 20,000 acres.

The gypsy moth continued to expand its range of activity, although total defoliation was down to 750,905 acres in 1974. Major decreases in acres defoliated occurred in Connecticut, Rhode Island, New York, and New Jersey, but in Massachusetts and Maine, defoliation acreage was nearly double that for 1973.

Major suppression projects by State-Federal cooperative programs were conducted on 190,000 acres using carbaryl, trichlorfon, or *Bacillus thuringiensis*. Gypsy moth parasite rearing and release activities occurred in several States within the general area of gypsy moth infestation. A parasite species for establishment of a native defoliator species was released in Wisconsin, although it is out of the general infested area. A combined suppression activity of the Animal and Plant Health Inspection Service (APHIS) and the Michigan Department of Agriculture was conducted on the gypsy moth infestation in central Michigan using carbaryl and combinations of carbaryl and disparlure. Intensive trapping surveys conducted by the Agriculture Research Service (ARS) and APHIS using disparlure showed a general decline in numbers of male moths trapped, but some spread to previously uninfested counties in Missouri, West Virginia, and Ohio was found. Infestations found in 1973 at Chapel Hill, N.C., and at Hungry Mother State Park, Va., were treated with carbaryl by ARS-APHIS.

The southern pine beetle outbreak continued to plague southeastern forest land managers and increased in intensity and acreage in Georgia, North Carolina, South Carolina, Tennessee, and Virginia, with localized increases in the other States. To date, about 53 million acres of commercial forests have been infested, and a concerted effort has been made by land managers to mitigate losses and suppress bettle populations.

Other insects of note in the East were the oak leaftier, cherry scallop shell moth, and hemlock looper in Pennsylvania, and the fall cankerworm in Virginia. The forest tent caterpillar continued its activity in Louisiana and Alabama.

Tree diseases for the most part were static throughout the east. There were, however, scattered incidences of increased activity. Dutch elm disease continued to spread in Wisconsin and Minnesota and intensified in New York. Beech bark disease caused mortality in beech stands in Pennsylvania, New York, New Hampshire, and Maine and moved westward in both New York and Pennsylvania. Ash dieback increased in parts of New York.

Air pollution affected trees in many eastern areas. Sulfur dioxide and fluorides caused plant injury in Tennessee, Arkansas, and Alabama, and oxidant pollution caused plant injury in Tennessee, North Carolina, Virginia, West Virginia, and Pennsylvania.

Western Conditions

The Douglas-fir tussock moth, western spruce budworm, and several species of bark beetles were the major insect pests in western forests of the contiguous United States.

The spear-marked black moth was the major insect pest in Alaska; in Oregon, Washington, and Idaho, the Douglas-fir tussock moth was the target of a suppression effort using DDT over 421,800 acres, with excellent population reductions. Pilot tests over 27,000 acres using *Bacillus thuringiensis* and a nuclear polyhedrosis virus were canceled because of natural population collapses.

Western spruce budworm defoliated nearly 4.2 million acres in Montana and Idaho, with the greatest increase in visible defoliation occurring in Montana east of the Continental Divide. Infestations in Washington increased, covering nearly 500,000 acres of Douglas-fir and true fir forests in 1974.

Several species of bark beetles, *Dendroctonus* and *Ips*, combined with adverse weather in many western forested areas to devastate stands of lodgepole and ponderosa pine. Salvage of dead and dying trees was hampered by the sagging economic situation. No artificial control activities were implemented.

The Modoc budworm greatly increased its acreage of defoliation in California, affecting 354,000 acres. Egg mass populations in the California infestation indicated a collapse of the population in 1975. An additional 90,000 acres of white fir were defoliated on the Fremont National Forest, and the outbreak in Oregon is expected to continue.

In Alaska, the spear-marked black moth caused late summer defoliation of birch over slightly more than 1.25 million acres. Pupal populations indicated that widespread defoliation will occur in 1975, but if past outbreak trends are followed, a marked decline will occur in late summer of 1975.

The western blackheaded budworm continued to increase. Although outbreaks were localized, approximately 18,000 acres were infested.

The problem of air pollution persisted in the Western United States and Alaska. Sulfur oxides, sulfur dioxides, and fluorides emitted from point sources caused damage to trees in Montana and Alaska. In California, extensive ozone damage was found in the southern Sierra Nevada. Extreme weather conditions, ranging from winter injury and drought to excessive rains, filled or predisposed trees to other destructive agents. Root diseases and dwarf mistletoes continued to cause damage in many western areas. Nursery diseases, particularly those caused by species of *Pythium*, *Fusarium*, and *Botrytis*, caused problems in California, Idaho, Oregon, and Washington nurseries.

FOREST INSECT AND DISEASE CONDITIONS BY REGIONS

ALASKA (R–10)

by

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Conditions in Brief

The largest insect outbreak of the year was a rapid upsurge of spear-marked black moth. A late summer defoliator, the insect caused leaf browning of paper birch along the Tanana and Yukon Rivers.

Spruce beetle activity on State land west of Cook Inlet occurred along the Beluga River drainage, north of the earlier Tyonek infestation. Previously high spruce beetle populations on the Kenai Peninsula subsided greatly.

North of Mt. McKinley, high populations of eastern larch bettle were detected for the second year. Aphids on paper birch generated public interest in the Matanuska and Susitna Valleys. Western black-headed budworm levels increased at various locations on the Tongass National Forest.

The following tabulation is a summary of the major insect outbreaks.

Insect	*Approximate acres infested*
Spear-marked black moth	1,298,000[1]
Spruce beetle	144,000
Eastern larch beetle	129,000[2]
Aphid complex (birch)	117,000
Western black-headed budworm	11,500[1]

Hemlock dwarf mistletoe and decay were common in southeast Alaska's old-growth forests, and in the coastal forest, hemlock dieback and abnormally high foliar sulfur levels occurred near Ketchikan and Sitka.

[1] Area of visible defoliation.
[2] Gross area of widely scattered infested trees.

Status of Insects

Spruce beetle, *Dendroctonus rufipennis* (Kby.). An outbreak of this insect persisted on the west side of Cook Inlet. Current tree mortality was concentrated north of the original Tyonek infestation, and there were 121,000 acres of infestation between the Chuitna River and Drill Creek near Beluga Lake. Tree mortality continued down the Beluga River drainage to the extent of spruce type. Many of the infested stands were mixed with muskeg openings and lacked the high density of large susceptible spruce so prevalent in parts of the original Tyonek infestation. Tree killing is, however, expected to intensify somewhat along the Beluga River in 1975.

Although most of the recent Tyonek infestation had declined to a normal level, there remained lingering tree killing in upper Chuitkilnachna Creek, Straight Creek, and the upper Chakachatna River flats. Most large diameter spruce in these areas had already died. The infestation is expected to decline markedly in 1975.

The smaller infestation near Red Glacier in lower Cook Inlet has subsided since 1973, with occasional Sitka spruce showing beetle attack symptoms.

The Kenai Peninsula spruce beetle outbreak of recent years declined still further in 1974. No significant infestation was observed by an aerial survey of the Peninsula. Because scattered distribution of spruce beetle infested trees can be detected more easily in the early rise of an outbreak than in the waning years, ground checks were conducted to verify the aerial survey. Low-level populations were found at all locations: Two Island, Barbara, Pepper, and Porcupine Lakes; Swanson River Road; and Wildwood Station.

Continued beetle surveillance on the Kenai is still necessary, particularly where stand depletion was low in past years and where large trees remain that are suitable for high beetle brood production. Of special interest were the perimeter of an approximately 3,000-acre burned area south of the Chickaloon River and patches of localized blowdown resulting from an early October 1974 windstorm.

A summary of recent spruce beetle outbreaks in the Cook Inlet area appears in the following tabulation.

Number of acres affected by spruce beetle

Year	*Kenai Peninsula*	*West side, Cook Inlet*	*Total*
Late 1960's through 1973	253,700	120,600	374,300
1974	300	143,000	143,700
Total	254,000	264,000	518,000

***Ips* beetles,** *Ips* spp. There was some concern by local residents over the possibility of an *Ips* beetle infestation in an Anchorage residential area. A considerable area of private land in the foothills above Upper O'Malley Road was burned during 1973, and spruce boles not excessively charred were infested by *Ips* beetles. When the surrounding undamaged spruce were checked on several dates during the summer and early fall, no sign of beetle attack was detected. Although it is improbable that the beetles would attack the healthy spruce trees, they will be watched closely throughout 1975.

During the summer of 1974, several acres of white spruce in Hillside Park south of Anchorage were burned. The damaged and surrounding undamaged spruce were checked for *Ips* beetles, with negative results.

A 1974 re-examination of the Yukon-Porcupine drainage system indicated that the earlier high populations of *Ips perturbatus* (Eichh.) and other *Ips* beetles have subsided. The condition was detected in 1973, apparently the last year of recent widespread infestation.

Eastern larch beetle, *Dendroctonus simplex* LeC. The insect occurs throughout the range of eastern larch in North America and is usually associated with injured trees or those dying from some other cause. The abnormal yellowing and mortality of eastern larch continued in the upper Kantishna River drainage, and broods of eastern larch beetle were numerous in recently killed trees. Affected trees were widely scattered over a 129,000-acre area. Yellow crowns were evident on the east side of the McKinley River from Chilchukabena Lake south of timberline, and to the west, yellow crowns were evident along upper Birch Creek and the upper Foraker River.

Spear-marked black moth, *Rheumaptera hastata* (L.). A late summer feeder, the spear-marked black moth built up rapidly from 1973 to 1974. An early August aerial survey indicated 1.3 million acres of moderate to heavy browning in mixed hardwood and spruce-hardwood stands. The outbreak extended generally from Indian Village on the Tanana River downstream to Ruby on the Yukon River. Discolored trees also occurred between Fairbanks and Livengood. Heavy defoliation did not occur in most Fairbanks residential areas except between miles 6 and 20 on the Chena Hot Springs Road.

This moth is commonly found in Alaska. The only other recorded outbreak occurred in 1957 and 1958, when populations surged relatively unnoticed to outbreak levels. By August 1958, 333,000 acres were heavily defoliated, but this outbreak rapidly declined because of granulosis virus and parasitism.

The following tabulation is a 1974 breakdown of moderately to heavily browned birch, according to 1:250,000 scale map sheets.

Maps	*Acres of moderate to heavy browning*
Big Delta	208,000
Fairbanks	172,000
Kantishna River	331,000
Livengood	108,000
Melozitna, Nulato, Ruby	114,000
Mt. Hayes, Tanacross	95,000
Mt. McKinley	5,000
Tanana	238,000
Talkeetna, Talkeetna Mountains	27,000
Total	1,298,000

The insect generally causes only tree growth loss. Localized branch dieback and tree mortality are possible, however, if heavy damage occurs on the same trees 2 or 3 years in a row.

Pupal populations indicated that widespread defoliation will occur again in 1975 (fig. 1). If the trend of the 1957–58 outbreak is followed, it is possible that the present spear-marked black moth population will have declined markedly by late summer.

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Figure 1.—Assessing overwintering pupal population of spear-marked black moth using a square-meter template.

Western black-headed budworm, *Acleris gloverana* (Wlshm.). Predicted increases in budworm populations continued to materialize in 1974, although outbreaks were localized. Moderate or heavy budworm defoliation occurred on western hemlock and to a lesser degree on Sitka spruce over at least 11,500 acres of southeast Alaska's Tongass National Forest. Defoliation was more prevalent on the Ketchikan Area, the southernmost administrative unit of the Tongass Forest. On Revillagigedo Island, budworm feeding was readily apparent on 1,200 acres at California Head. Although defoliating insect populations were low in most of Ward Creek near Ketchikan, there were approximately 100 acres of vividly red-crowned trees near the junction of the Ward Creek-White River Road and the main highway. Although hemlock sawfly was present in this localized patch, a high budworm population caused most of the defoliation. Other areas of conspicuous tree discoloration included Betton and Clover Islands, north of Ketchikan, where 1,700 acres of defoliation occurred.

Three areas of defoliation were conspicuous to the north on the Stikine Area: approximately 2,700 acres along Bradfield Canal, east of Martin Creek; 600 acres near the city of Wrangell; and 500 acres on Eagle Island. Other areas ranging in size from 100 to 600 acres were defoliated on the Ketchikan and Stikine Range areas. Defoliation was also observed farther north, on the 2,200 acres surrounding Fresh Water Lake on Admiralty Island.

Low defoliator populations in most of Ward Creek provided an opportunity to examine permanent plots previously established in the drainage. Trees on the plots had recently undergone severe sawfly defoliation as well as exposure to high levels of ambient sulfur oxide. With the decline of insect numbers, refoliation began and some top kill and tree mortality were readily discernible.

An annual larval survey in southeast Alaska for defoliators of western hemlock was conducted during the first 2 weeks of August 1974, in cooperation with entomologists of the Forestry Sciences Laboratory, Juneau. One of the more serious defoliators is the western black-headed budworm. A comparison of 1973 and 1974 budworm counts did not bear out the increases in localized defoliated areas observed in 1974. California Cove, an area that showed an increase in defoliation in 1974, had a very high budworm count but it was still lower than that for 1973. Budworm egg samples collected in October indicated that additional budworm outbreaks are likely in 1975.

Hemlock sawfly, *Neodiprion tsugae* (Midd.). A larval survey in southeast Alaska showed that hemlock sawfly larvae have decreased from 1973 to 1974. Low egg counts in the fall of 1973 indicated such a decrease, and because of the cool, wet summer in 1974, hemlock sawfly populations will most likely be low again in 1975.

Operophtera hyperboreata (Hulst). For the third consecutive year, defoliation of deciduous trees and shrubs by the larvae of these moths was observed on Kodiak and Raspberry Islands. Ground observations were made at points along

the road south from the city of Kodiak to Karluk Lake and on Amook Island and Little River Island. The primary plants affected were alder, willow, cottonwood, elderberry, and high bush-cranberry. Plant damage is expected to be confined primarily to twigs and branches, and looper populations are expected to decline in 1975.

Aphid complex. A complex of aphids, primarily on paper birch, generated the interest of Anchorage residents. Although an aerial survey of the city did not indicate significant tree discoloration, homeowners noticed the insects and the sticky "honeydew" that they produce. Both the State and the Forest Service received inquiries as to the seriousness of aphid feeding and the measures that individuals might take to reduce the nuisance.

When viewed from the air, some birch in mixed spruce hardwood stands in the Palmer area displayed noticeable browning. Individual tree browning extended over 117,000 acres, from near Chickaloon down the Matanuska River and westward between the Talkeetna Mountains and Knik Arm. Very little tree browning was detected west of Lucile Lake.

Other insects. Residents of Seward noticed damage to some ornamental white spruce in midsummer. Many new buds had been killed, and needles on some twigs were turning brown from the tips of the twigs inward. When twig samples were examined, it appeared that they had been damaged by the larvae of a spruce bud moth, *Zeiraphera* sp. There is probably not much danger of tree mortality unless spruce are attacked heavily for several years in a row. Lighter attacks will cause the trees to branch excessively, which will result in an unsightly appearance.

Sitka spruce seed damaged by the spruce seed moth, *Laspeyresia youngana* (Kft.), was collected on the Valley Sale Area at Raspberry Strait, Afognak Island, in the fall of 1973. In subsamples of 5,886 seeds, 32.6 percent of the seeds were insect damaged.[3]

[3] Data on file at Forestry Sciences Laboratory, Juneau.

Status of Diseases

Sirococcus shoot blight, *Sirococcus strobilinus* (Preuss.). Thomas Bay near Petersburg was the hot spot for *Sirococcus* activity. Plots established in uninfected western hemlock reproduction in the spring of 1974 were 70 percent infected by late summer. Furthermore, an infected hemlock was reported in Juneau, the first time the disease has been spotted north of Frederick Sound.

Undetermined hemlock mortality. An unidentified disease continued to cause mortality in western hemlock at Edna Bay on Kosciusko Island. Most of the mortality occurred in stands that were partially harvested in the 1940's. Scattered hemlock in all age classes showed crown deterioration and mortality progressing from the lower branches toward the top. The timespan from first symptoms to death and loss of all needles is one season, with most of the mortality in the younger age classes.

Air pollution. Tree mortality continued to be a problem in the vicinity of a pulpmill at Sitka. Chronic exposure to sulfur oxide emissions was associated with foliar injury to understory vegetation and with the mortality of Sitka spruce, western hemlock, and Alaska cedar over approximately 1,200 acres.

Typical symptoms of sulfur oxide injury were found on the foliage of conifers and associated plants near a pulpmill at Ketchikan. In western hemlock, damage evaluation was complicated by a high incidence of dwarf mistletoe and recent insect defoliation. Mortality and top kill were generally more prevalent in large, older hemlock.

Foliage samples collected along transects near the Sitka and Ketchikan pulpmills were analyzed for total sulfur. Sulfur concentrations were highest near the mills and generally diminished with increasing distance from the mills. A high of 6,300 parts per million was found at Ketchikan in a sample of Sitka spruce foliage (fig. 2); the high at Sitka was 6,700 parts per million. Background samples from similar stands in the same areas, but unexposed to sulfur oxide emissions, had total sulfur contents of 400 to 800 parts per million.

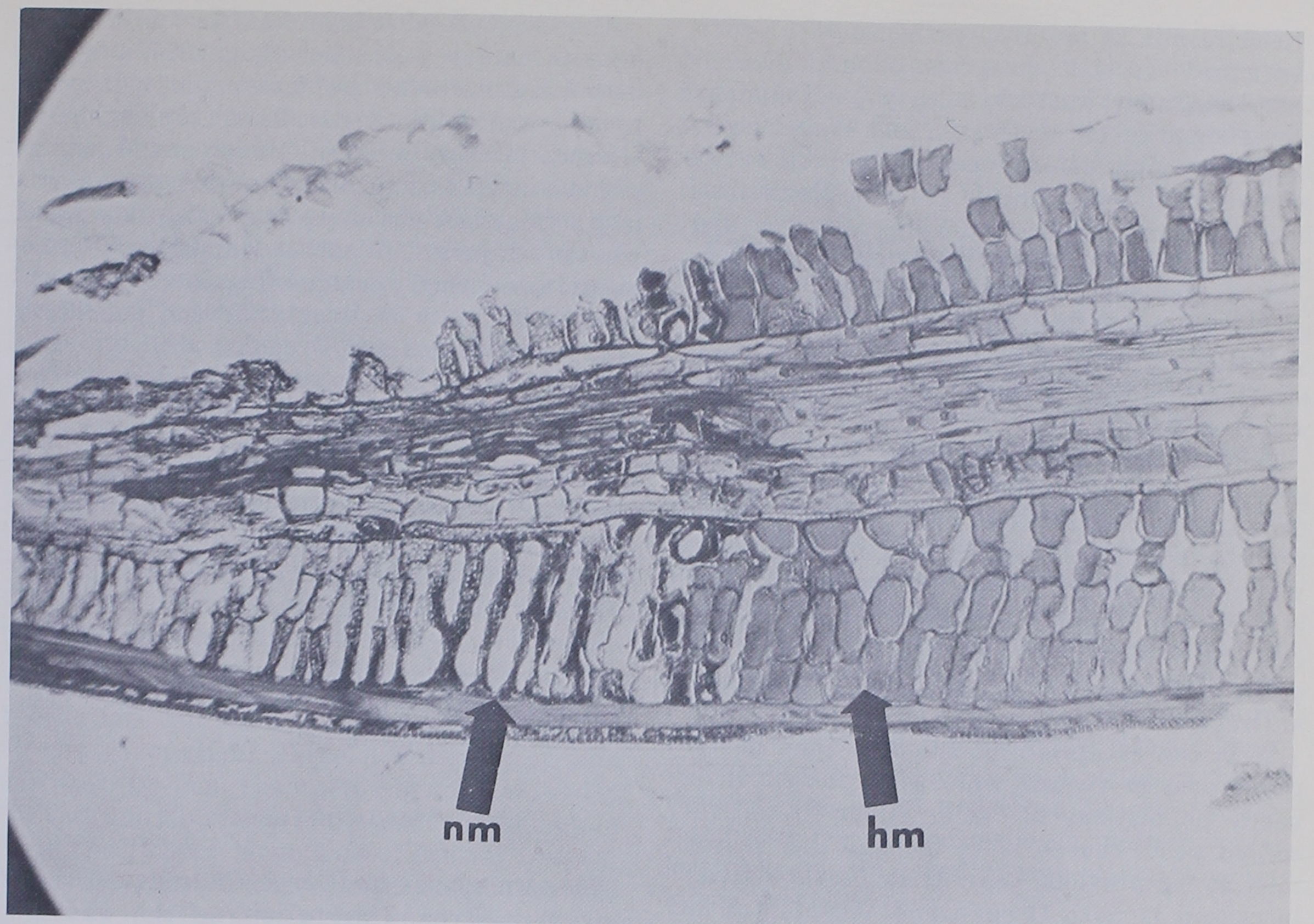

Figure 2.—Sulfur-damaged Sitka spruce needle, longitudinal section; nm=necrotic mesophyll; hm=healthy mesophyll.

OREGON AND WASHINGTON (R–6)

by

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Conditions in Brief

Defoliator populations continued at a high level in the Pacific Northwest as a result of substantially increased activity of the western spruce budworm in north-central Washington and the Modoc budworm in south-central Oregon. Western spruce budworm infestations caused damage over approximately 548,000 acres—more than double the area of 1973—of Douglas-fir and true fir forests on the Okanogan and Wenatchee National Forests and the North Cascades National Park. One new infestation center, totaling 7,200 acres and consisting primarily of light defoliation, was observed on the Warm Springs Indian Reservation, Oreg.

The Modoc budworm caused primarily light defoliation over approximately 90,000 acres of white fir type in the Gearhart and Warner Mountains on the Fremont National Forest; this is double the area of visible damage found in 1973. Sugar pine tortrix observed in the North Warner Mountains caused light defoliation over 760 acres of lodgepole pine. Larch casebearer defoliation was again observed in both States. Field observers indicated that the intensity of overall damage appeared to be generally less in 1974 when compared to 1973.

The results of the 1974 aerial survey, which confirmed the post-spray sampling, indicated that Douglas-fir tussock moth populations declined significantly in Oregon and Washington. Some additional defoliation was observed in the near research study sites in the Blue Mountains, in portions of the Eagle Cap Wilderness area, and in the untreated breaks of the Snake River Canyon. No significant defoliation, however, was observed in any of the treatment areas, and only one new center, totaling less than 10 acres and located in Stevens County near Daisy, Wash., was recorded.

Balsam woolly aphid activity decreased in Oregon, although specimens and damage resulting from this pest were found on subalpine fir near the headwaters of Tiger Creek on the Walla Walla Range District, Umatilla National Forest, in May 1974. This is a new record and a significant range extension because this aphid has never been found east of the Cascade Mountains in Oregon.

With the exception of mountain pine beetle populations in western white pine, and silver fir beetle populations in Pacific silver fir, all recorded pests caused more damage this season than in the previous year. Bark beetle activity increased in both Oregon and Washington in 1974. The volume of the mountain pine beetle has more than doubled since last year and has killed approximately 79.7 thousand board feet in lodgepole pine stands in eastern Oregon. This is a result of recorded tree mortality on nearly 423,000 acres of host type concentrated mostly on the Umatilla and Wallowa-Whitman National Forests and on adjacent State and private lands. Fir engraver damage more than doubled in Oregon and decreased slightly in Washington. Douglas-fir beetle losses were generally light and scattered over both States, but extensive tree killing, presumably triggered by brood buildup in ice storm damaged and drought-weakened trees, occurred over nearly 10,000 acres in the Cascade Mountains between Packwood and Randle, Wash. Western pine beetle losses in both Oregon and Washington remained at about the same level as 1973, but increased activity was observed on the Fremont, Malheur, Ochoco, and Winema National Forests in Oregon. An unusual outbreak of the flatheaded fir borer, developing in drought-weakened Douglas-fir, caused tree killing on approximately 5,500 acres in southern Oregon between Roseburg and Medford.

The incidence of foliage diseases and weather injuries increased considerably in 1974, affecting both forest nurseries and forest stands. Damage by gray mold blight and Fusarium top blight was common in many western Oregon and Washington nurseries, and several Christmas tree plantings suffered serious losses from foliage rusts and weather injuries. Weather damage was suspected as a primary contributing factor in the extensive mortality in Douglas-fir and ponderosa pine stands in southern Oregon.

A 1974 Forest Service survey to determine the types of diseases and the degree of infestation found in 30 lodgepole pine stands revealed that: western gall rust was present in 23 stands and more than 28 percent of the trees were infected; dwarf mistletoe was present in 20 stands; stalactiforme rust was present in 8 stands; and atropellis canker was found in 9 stands.

Root rots, heart rots, and dwarf mistletoes continue to be the most important forest disease problems in the Pacific Northwest, with little change in yearly incidence.

Status of Insects

Western spruce budworm, *Choristoneura occidentalis* Free. Infestations of the western spruce budworm have more than doubled in area since last year. Slightly more than one-half million acres of Douglas-fir and true fir were defoliated to some extent this year. The majority of the damage occurred on the Okanogan and Wenatchee National Forests and in the North Cascades National Park in north-central Washington. Scattered defoliation, less than 2,000 acres, occurred on the Wallowa-Whitman National Forest in Oregon, and a new center, consisting of 7,200 acres and undergoing primarily light defoliation, was recorded on the Warm Springs Indian Reservation. Some top killing occurred as a result of continuous defoliation over the past 4 years on the Okanogan and Wenatchee National Forests, but no mortality was observed. These outbreaks are expected to continue in 1975. Although no control action will be taken next year, one or more areas are being considered as sites for field testing of insecticides that have shown promise against this insect.

Modoc budworm, *Choristoneura viridis* Free. Populations of this insect, more than doubling in area, caused primarily light defoliation over ap-

proximately 90,000 acres of white fir type on the Fremont National Forest. New defoliation occurred this year over most of the North Warner Mountains and the Gearhart Wilderness Area, but this current level of defoliation did not result in serious tree damage. Cone production was affected and some scattered top killing was observed in isolated locations that have suffered 3 years of continuous defoliation. No mortality was observed. These outbreaks are expected to continue into 1975, but no control action is planned.

Sugar pine tortrix, *Choristoneura lambertiana* (Busck). A new center, consisting of 720 acres and undergoing primarily light defoliation, was observed in the vicinity of Drake Mountain (North Warner Mountains) on the Lakeview Ranger District, Fremont National Forest; however, it is not expected to cause any serious problems next year.

Larch casebearer, *Coleophora laricella* Hbn. Infestations continued to spread in western larch stands throughout eastern Washington and northeast Oregon. The insect was not observed in the Cascade Mountains of Oregon or Washington, or in the Ochoco Mountains of central Oregon. Field observers indicated that defoliation was generally less than that of last year. This may, in part, have been a result of the cool and damp weather that occurred throughout much of the Pacific Northwest this last spring.

Douglas-fir tussock moth, *Orgyia pseudotsugata* McD. Populations of this pest were reduced to nearly nondetectable levels following the application in 1974 of DDT on 356,505 acres of infested forest lands in Oregon and Washington. In areas treated, no significant defoliation was observed and only one new center, less than 10 acres in Stevens County, Wash., was reported. Following completion of the suppression project, approximately 2,200 miles of timberland road system in Oregon and Washington were surveyed for tussock moth larvae; no active populations were found.

The results of a recently completed egg mass survey showed no egg mass populations in any of the treatment areas except on the Pomeroy Unit in the vicinity of Anatone Butte. No additional control efforts were considered necessary. The remaining population centers will be closely monitored in the spring of 1975 to determine their damage potential.

The tussock moth population on the Winema National Forest, located in the vicinity of Klamath Lake, is one of the oldest continuous populations in the Northwest, having been in existence since 1971. Except for very light defoliation, damage was not visible from the air.

Balsam woolly aphid, *Adelges piceae* (Ratz.). Infestations continued to cause damage in the true fir stands of western Oregon and Washington, but the amount of visible damage detected during the annual aerial survey in Oregon was approximately 100,000 acres less than the amount observed in 1973. Most of the observable damage occurred on the Willamette, Mt. Hood, and Deschutes National Forests in Oregon and on the Gifford Pinchot and Snoqualmie National Forests in Washington. A light infestation not detectable from the air was found in a small grove of subalpine fir near the headwaters of Tiger Creek on the Walla Walla Ranger District, Umatilla National Forest, in May 1974. The results of a recent ground survey indicated that the insect was established in the subalpine type within a 3-mile radius of the initial find. Bole dissections indicated that host trees had been infested for at least 7 years. No grand fir tree mortality or top killing was observed.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. Populations continued to cause serious losses in lodgepole pine stands in Oregon, killing approximately 80 million board feet of timber this past year. Nearly three-quarters of this loss occurred on the Umatilla and Wallowa-Whitman National Forests. In Washington, losses in lodgepole pine continued to be light, and losses of western white pine declined throughout the mountainous regions of both States. In Oregon, the heaviest tree killing occurred on the Willamette National Forest, while those in Washington occurred on the Snoqualmie and Wenatchee National Forests. Mountain pine beetle attacks in pole-size ponderosa pine increased slightly in both States, with significant increases occurring in the Coleville Indian Reservation in Washington and on State and private lands in the vicinity of Dooley Mountain in northeastern Oregon.

Fir engraver, *Scolytus ventralis* Lec. Populations have generally increased over the Pacific Northwest. Significant damage in Oregon occurred on the Malheur, Umatilla, and

Wallaowa-Whitman National Forests. In Washington, the Mt. Baker, Okanogan, and Wenatchee National Forests received the most damage. The trend of these infestations is unknown.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Populations infected some 28,000 acres of Douglas-fir in Oregon and Washington in 1974, with losses more than twice those of 1973. The longest lasting outbreaks were observed on the Mt. Hood, Umpqua, Willamette, and Gifford Pinchot National Forests. The most extensive infestation was located on the Packwood Ranger District of the Gifford Pinchot National Forest within and adjacent to the Davis Mountain nonselected inventoried roadless area. An estimated 75 million board feet of dead, green-infested and ice storm damaged timber had been prepared for sale this fall. The District is hopeful that the infested material will be logged by May 1, 1975, before the beetles emerge to infest other trees.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). Tree killing continued in Englemann spruce stands on the Okanogan National Forest in Washington. Elsewhere in Oregon and Washington, spruce beetle populations were generally increasing. Aerial detection surveys reported numerous widely scattered new patches of mortality. The trend of these outbreaks is unknown.

Western pine beetle, *Dendroctonus brevicomis* LeC. Infestations continued in several mature and overmature ponderosa pine stands in central Oregon, where nearly 7 million board feet of timber were killed on the Fremont, Malheur, Ochoco, and Winema National Forests. In Washington, losses were light, with widely scattered tree killing occurring on most forests in the eastern section of the State.

Flatheaded fir borer, *Melanophila drummondi* (Kirby). An outbreak of flatheaded borers developed on approximately 5,500 acres of low-site forest lands in southwestern Oregon between Roseburg and the Oregon-California State line. Most of the tree killing occurred on dry, rocky sites located along the foothills of the Rogue and Umpqua River drainages in the vicinity of Riddle, Grants Pass, Medford, and Ashland. The probable cause of this outbreak is the effect of adverse weather conditions on host trees, such as the unusually low temperatures in December 1972, followed by a long and severe drought in 1973.

European pine shoot moth, *Rhyacionia buoliana* (Schiff). The European pine shoot moth pheromone was used operationally for the first time as a survey tool. Baited sticky traps were placed in the field from May through July in Jackson, Josephine, Clackamas, Washington, Multnomah, and Umatilla Counties, Oreg. Adults were found at Hermiston, Umatilla, Hat Rock Park, and McNary Golf Course and in a residential area of Pendleton, all within Umatilla County. No shoot moths were detected in the other five counties.

Gypsy moth, *Lymantria dispar* (L.). An adult male was captured this past summer in a pheromone trap placed in a residential area in Seattle, Wash. No additional adults were captured. According to Dick Jackson, USDA Plant Protection Officer, additional evidence of gypsy moth was found on mobile homes in Coeur d'Alene, Idaho, and in Bend and Pendleton, Oreg. The find at Bend included dead larvae and an old egg mass. Followup surveys are planned for 1975.

Other Insects. Pine engraver, *Ips pini* (Say), mortality increased over last year, occurring over approximately 17,000 acres. Most of the damage was recorded in Eastern Oregon; eastern Washington had little damage. The larch sawfly, *Pristiphora erichsonii* (Htg.), caused visible defoliation on approximately 600 acres on the Mt. Hood National Forest, Oreg. An unidentified sawfly, *Neodiprion* spp., continued to cause light defoliation on about 1,100 acres of knobcone pine in southwest Oregon. Cone bug, *Leptoglossus occidentalis* Heidemann, damage was observed in mixed pine seed orchards at Dorena Reservoir on the Umpqua National Forest. The principal species affected, western white pine, is being used to produce seed for progeny testing for resistance to white pine blister rust. The pandora moth, *Coloradia pandora* Blake, caused light defoliation over nearly 10,000 acres of mixed ponderosa pine and lodgepole pine stands on the Deschutes National Forest in central Oregon. A moth flight is expected to occur in the area during 1975.

Gray mold blight, *Botrytis cinerea* Pers. This blight damaged seedlings in many forest nurseries in western Oregon and Washington. The increase in damage is directly attributable to the prolonged moist period, which extended into late June. The disease is most damaging in dense beds where the foliage remains damp for several days, and can be prevented by thinning beds to promote foliage drying. Several fungicides, including bordeaux, maneb, zineb, ferbam, captan, and thiram, are effective in preventing gray mold blight.

Furasium top blight, *Fusarium* spp. This disease, which was common to many forest nurseries this year, can be prevented by avoiding excess moisture on foliage for long periods. The Washington Department of Natural Resources found Benlate® to be effective in preventing the disease.

Douglas-fir needle rust, *Melampsora occidentalis* Jacks. Several Christmas tree plantings in Oregon and Washington were damaged by this disease in 1974. In some cases, trees were so severely infected that they were rendered worthless for Christmas trees. The rust has an alternate host of black cottonwood. Damage can be reduced by removing cottonwood trees from the immediate vicinity of Douglas-fir Christmas tree plantings. This disease appears occasionally in the Pacific Northwest.

Other foliage diseases. *Melapsora abieticapraearum* Tub. was observed on approximately 200 acres of grand fir on the Yakima Indian Reservation; a *Dothistroma-Lophodermium* complex on lodgepole pine was found along the coast of Oregon; and *Rhabdocline pseudotsugae* Syd. was present on Douglas-firs in many areas of Oregon and Washington. Larch needle cast, caused by *Hypodermella laricis* Tub., was observed in several larch stands in eastern Washington and northeastern Oregon.

Port-Orford-cedar root rot, *Phytophthora lateralis* Tucker and Milbrath. A roadside survey of this fungus was conducted in three Districts of the Siskiyou National Forest in 1974. Approximately 55 percent of the 450-plus miles of roads examined had infected trees along the roadsides. This represents a dramatic increase from a similar survey conducted in 1964, when the root rot was just beginning to encroach on the Forest.

Dutch elm disease, Certocystis ulmi (Buism.) C. Mor. In 1973, Dutch elm disease was detected in Ontario and in Nyssa, Oreg. In 1974, the disease was found in Union, Oreg., approximately 90 miles from Ontario.

Dwarf mistletoe, *Arceuthobium* spp. Seed production by Douglas-fir dwarf mistletoes, *Arceuthobium douglasii,* and Engelmann spruce and larch dwarf mistletoe, *A. laricis* (Piper) St. John, was very poor in 1974. Unfortunately, ponderosa pine dwarf mistletoe, *A. campylopodum* Engelm., produced a bumper crop.

Weather damage. Weather injury to several tree species was very noticeable in 1974. Extensive drought injury or scorch occurred over much of western Washington, apparently because of a single week of extremely hot weather early in June, when foliage was succulent. Many of the grand fir in Washington Christmas tree plantations also had some degree of damage; noble fir and Douglas-fir were affected to a lesser degree.

Freeze damage to the tops of conifers was common in the vicinity of Olympia, Wash.; the top 5–20 feet of each tree damaged were killed by low temperatures.

Weather injury is strongly suspected as a contributing factor of extensive mortality of Douglas-fir and ponderosa pines in southern Oregon between Roseburg and Medford. An area around Canyonville and Riddle was highly visible from Route I–5 and generated considerable news coverage. Extremely cold weather experienced during December 1972 is suspected as the initial cause of the injury. Secondary damage by bark beetles was evident in dead and stressed trees. The Oregon State Department of Forestry is conducting additional evaluations in the damaged areas.

Other diseases. Several additional infection centers of black stain root disease were found in Douglas-fir stands in the vicinity of the Umpqua National Forest. Many infection centers that appeared to be caused by *Phellinus weirii* (Murr.) were really caused by the black stain root disease, *Verticicladiella wagenerii* Kendrick. Normally, only a relatively small number of trees is killed in any one infection center.

A survey of 261 plantations revealed that Armillaria root rot was the most common disease in both Oregon and Washington. White pine blister rust, *Phellinus weirii*, and weather injury were also frequently observed diseases.

CALIFORNIA AND HAWAII (R–5)

by

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Conditions in Brief

In 1974, the Modoc budworm was the cause of the largest forest defoliator outbreak ever recorded in California—gross area infected increased from 148,000 to 354,000 acres, with 90,000 acres of this expansion in the Warner Mountains of southern Oregon. Fall egg-mass surveys (fig. 3) indicated that budworm populations will be greatly reduced in 1975, and a corresponding decline in tree damage is expected.

Other defoliators were also active: white fir sawflies continued widespread feeding on true firs on the Tahoe, Plumas, and Eldorado National Forests; an outbreak of pine needle miners enlarged in the San Bernardino Mountains of southern California; and black pineleaf scale damaged trees near Glenburn and Lake City in northern California.

Tree killing by bark beetles increased in some areas, and the fir flatheaded borer killed many Douglas-fir trees in northwestern California.

A cold winter and wet spring contributed to increased incidence of foliage and twig diseases on conifers and hardwoods. Sycamore anthracnose and *Ascochyta* leafspot were prevalent in the foothills and in coastal forests.

Widespread smog damage was detected on the Sierra, Sequoia, Los Padres, and Cleveland National Forests and in Sequoia and Kings Canyon National Parks. This was the first report of extensive smog damage to forests outside the Los Angeles air basin.

F-742433

Figure 3.—Prespray sampling of Modoc budworm (California). Prior to the pilot test of Dylox for Modoc budworm control, a forestry technician uses a pole pruner to collect samples from a white fir; the larvae are then examined in the laboratory and their development assessed in order to determine the optimum spray date.

Eurasian pine aphids continued to be the most destructive forest pest in Hawaii. Two new outbreaks and several continuing ones caused some mortality in pine stands on the islands of Hawaii and Maui. Twig dieback due to black twin borer infestations remained a problem throughout the native exotic forests.

Ohia forest decline continued to be the State's most serious disease problem. At least 200,000 acres of ohia forests were in varying degrees of decline. Needle cast disease caused considerable mortality within pine stands on the islands of Maui and Molokai.

Status of Insects—California

Budworm, *Choristoneura* spp. Defoliation of conifers on the Modoc National Forest spread and intensified as predicted last year. The principal

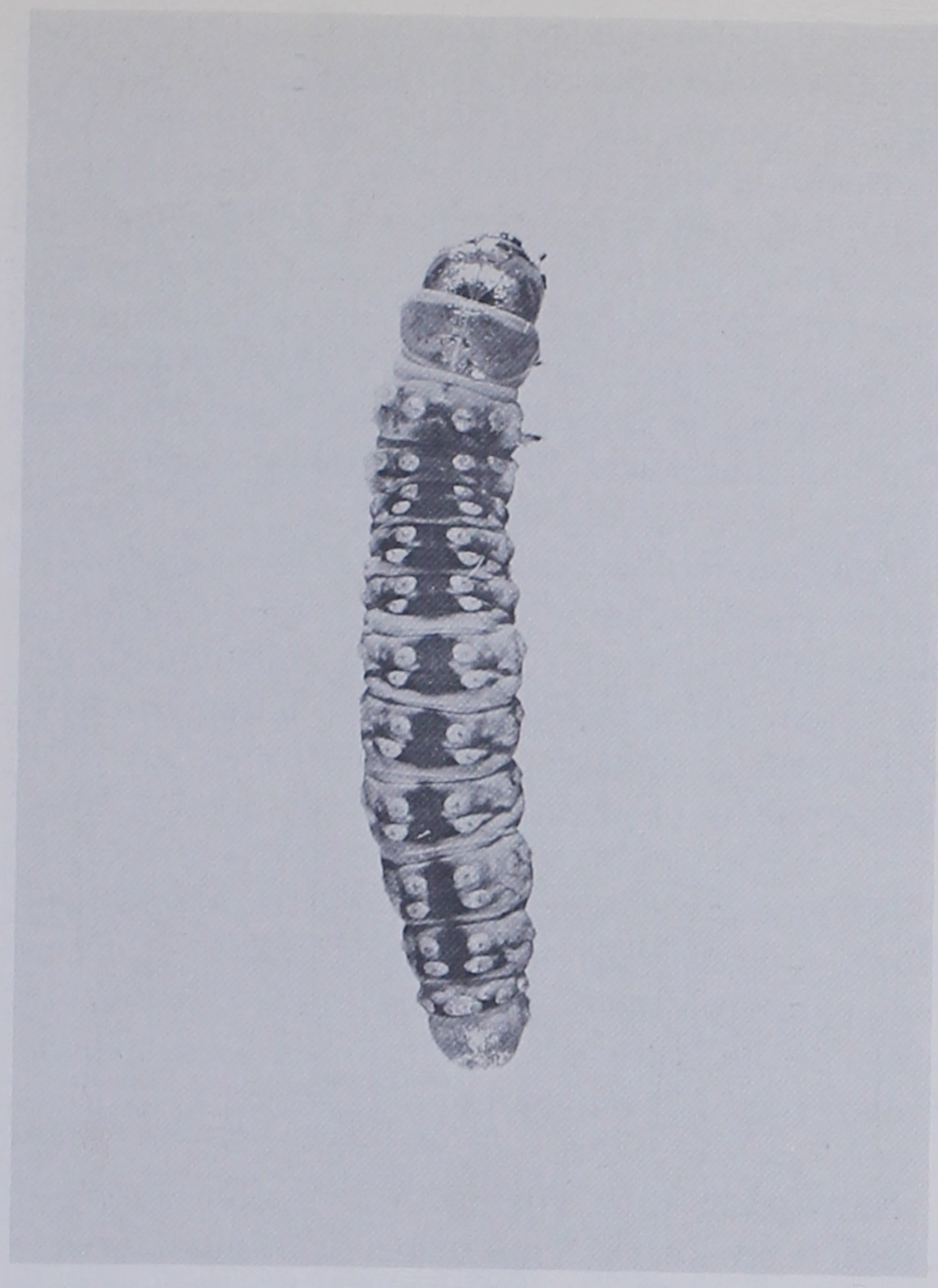

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Figure 4.—The larvae (length 0.8 inch) of the Modoc budworm *(Christoneura viridis* Freeman) are spotted and pale green (California).

pests were the Modoc budworm (*C. viridis* Freeman) on white fir (fig. 4), and the sugar pine tortrix (*C. lambertiana subretiniana* Obraztsov) on lodgepole, western white, and whitebark pines. The outbreak affected a gross area of about 354,000 acres, including the entire Warner Mountain range from northern Lassen County to Southern Oregon, and a large area at Manzanita Mountain east of Adin. As observed by aerial surveys, the net area of defoliated trees was 248,485 acres, as shown in table 1.

Table 1.—Number of acres affected, by degree of infestation

	Slight	Moderate	Severe	Total
Modoc budworm				
California	53,295	70,520	19,200	143,035
Oregon	70,080	12,370	5,160	87,610
Sugar pine tortrix				
California	—	—	—	17,080
Oregon	—	—	—	760
Total				248,485

Budworms were also detected on the Plumas and Eldorado National Forests, but the populations were judged to be innocuous.

White fir sawfly, *Neodiprion abietis* (Harris). White fir sawflies continued to cause conspicuous defoliation in several locations on the Plumas, Tahoe, and Eldorado National Forests. Surveys conducted in early winter showed declining populations in the three areas evaluated; additional surveys were planned for spring 1975.

Gypsy moth, *Lymantria dispar* (L.). Despite the continued introduction of immature gypsy moths into California—primarily as egg masses attached to recreational vehicles—no established infestation has been found. Pheromone traps yielded one male moth in Berkeley in 1973, and one additional male in Yosmite National Park in September 1974. Followup surveys by California Department of Food and Agriculture quarantine teams produced negative results, indicating the absence of adult moths capable of reproduction.

Needle miners, *Coleotechnites* spp. The lodgepole needle miner, *C. milleri* (Busck), continued to defoliate lodgepole pines in the long-established infestation in Yosemite National Park. Because of the unusually cold winter of 1972–73, the current population was reduced to the level of 1970.

Another *Coleotechnites* sp. expanded the area of damage to Jeffrey pines at Snow Valley, Big Bear, and Santa Ana River in the San Bernardino National Forest. The defoliation in the Santa Ana River drainage was an extension of the infestation into a new area. A third *Coleotechnites* sp. was reported defoliating pinyon pines on Santa Rosa Mountain in Riverside County.

Fir needle miners, *Epinotia meritana* Heinrich and *E. hopkinsana* (Kearfett), were part of the complex of insects involved in the budworm outbreaks on the Modoc National Forest.

Black pineleaf scale, *Nuculaspis californica* (Coleman). Severe outbreaks of black pineleaf scale on sugar pines have declined greatly in the Two localized outbreaks developed near Lake City in Modoc County, and an older infestation continued to weaken trees near Glenburn in Shasta County. At Glenburn, scale-weakened trees fell prey to western pine beetles also.

The widespread infestations of black pineleaf scale on sugar pines have declined greatly in the last 2 years. Aerial surveys revealed localized scale damage to sugar pines north of Fort Jones in Siskiyou county, north of Stirling City in Butte County, and south of Burney in Shasta County.

Primary flatheaded borers, *Melanophila* spp. Fir flatheaded borers, *M. drummondi* Kby., killed thousands of Douglas-fir trees in northwestern California. Losses were most pronounced on the Klamath National Forest in the Salmon River drainage between forks of the Salmon and Cecilville, where 450,000 board feet of infested trees were scheduled for salvage. Tree killing was also very evident on parts of the Shasta-Trinity National Forest. Both infestations are believed to be temporary conditions resulting from a period of drought during winter 1972–73.

California flatheaded borers, *M. californica* VanD. These insects continued to kill Jeffrey pines in southern California. The borers were suppressed by spraying felled infested trees at Wrightwood, San Bernardino County, and on Laguna Mountain, San Diego County. On private lands in Garner Valley, Riverside County, indirect control by sanitation salvage provided encouraging results.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. Infestations of the mountain pine beetle declined in recreation forests, although increased activity was detected in some commercial forests. Death of lodgepole pines caused by mountain pine beetles increased greatly in portions of the Warner Mountains of the Modoc National Forest. Group killing of young sugar pines was also reported south of Huntington Lake on the Sierra National Forest.

Pine engraver beetles. *Ips.* spp. Numerous reports of typical *Ips* activity were received during during 1974. The most significant conditions were late summer infestations killing crop trees in thinned stands on the Lassen National Forest.

Western pine beetle, *Dendroctonus brevicomis* LeC. Tree losses attributed to the western pine beetle were evident in several locations. Direct chemical control continued in the recreation forests of southern California, and salvage logging was carried out elsewhere. In one such operation, Fruit Growers Supply Company salvaged infested trees southwest of Highway 89 near Hat Creek in Shasta County. Efforts to salvage infested trees at Glenburn were hampered by adverse market conditions. Trees continued to be killed by the persistent infestation at McCloud Flats on the Shasta-Trinity National Forest.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Previously reported Douglas-fir beetle infestations on the Plumas National Forest persisted, but at a reduced level. Efforts to control losses by salvage logging continued but were hampered by economic factors.

Jeffrey pine beetle, *Dendroctonus jeffreyi* Hopk. Increased tree killing by this beetle was noticeable in Lassen National Park, on adjacent areas of the Lassen National Forest, and around Fallen Leaf Lake near Lake Tahoe.

Nantucket pine tip moth, *Rhyacionia frustrana* (Comstock). This insect continued severe tip killing of Monterey pine landscape trees in San Diego County, and a separate infestation in a Christmas tree plantation near Bakersfield also persisted. Observations indicated that areas infested, although more numerous, were smaller than anticipated, bolstering hope for containment or eradication of this pest.

Other insects. Pine resin midges, *Cecidomyia piniiopis* O.S., were detected killing branch tips in several pine plantations at widely scattered locations in northern California. Needle sheath miners, *Zelleria haimbachi* Busck, were active also, most notably in pine plantations adjacent to Highway 89 near Mt. Shasta, where the pests had defoliated an estimated 1,200 acres of planted pines on the Shasta-Trinity National Forest. Grasshopper infestations declined, damaging only a few locations. The first reports of activity in several years by Douglas-fir gall midges, *Contarinia* spp., indicated that the pest had caused slight damage to small Douglas-fir trees in the Seiad Valley and at Frog Pond in Siskiyou County. More severe damage was noted around Placerville in Eldorado County.

F-523624
Figure 5.—Eurasian pine aphids cover this branch of a Monterey pine sapling.

Status of Insects—Hawaii

Eurasian pine aphid, *Pineus pini* Koch. The Eurasian pine aphid was first detected in 1970 at Waikii on Hawaii Island. During the past year, pine aphid infestations were found at Kemole (5 miles north of Waikii) and at Puu Waawaa (14 miles southwest of Waikii). Several dead trees were detected at Puu Waawaa, indicating that the aphid infestation had been present for some time.

The Maui Island infestation was first recorded in August 1971 on backyard pine bonsai plants. In July 1973, the aphids were detected on two pine trees in the Waihou Forest Reserve and on one tree in the Kula Forest Reserve on Maui. Infested trees were cut and destroyed.

An August 1974 survey in the Waihou Spring, Kula, and Makawao Forest Reserves revealed that the pine aphid infestation had increased considerably in the Waihou Spring Forest Reserve. One pine sapling in the Makawao Forest Reserve was heavily infested with the aphid. Although the pine aphid was not detected in the Kula Forest Reserve, a November detection report indicated a single *Pinus pinaster* tree was heavily infested. This infestation was 4 miles west of the original infestation in the Kula Forest Reserve.

Thus far, the Eurasian pine aphid (fig. 5) has been recorded from *Pinus pinaster*, *P. radiata*, *P. taeda*, *P. patula*, *P. elleottii*, *P. thumbergii*, and *P. densiflora* in the State.

Black twig borer, *Xylosandrus compactus* Eichoff. This scolytid beetle was recorded from Molokai Island for the first time time last year. Excluding Lanai Island, the beetle is now on all the major Hawaiian Islands. No serious outbreaks of this beetle were reported during 1974.

Acacia psyllid, *Psylla uncatoides* (Ferris & Klyver). This sapsucking insect is a pest of native koaia (*Acacia koaia* Hbd.), koa (*A. koa* Gray), and the introduced Formosan koa (*A. confusa* Merr.). Damage occurred primarily on the new flushing terminal growth, causing dieback, growth retardation, and general weakening of the trees. Damage to koa and koaia was negligible on all the major Hawaiian Islands; there was, however, a typical population peaking on Hawaii Island during March, corresponding with the flushing period at the koaia sanctuary and along the Mauna Loa strip road. During the past year, two ladybird beetle species, *Harmonia conformis* (Bois.) and *Diomus* sp., were released on Hawaii at the koaia sanctuary and along the Mauna Loa strip road by the State Department of Agriculture and the University of Hawaii Entomology Department. Thus far, only *H. conformis* (fig. 6) is established at the koaia sanctuary and is doing an excellent job suppressing the acacia psyllid.

Carolina coniferous aphid, *Cinera caroline* Tissot. Caroline coniferous aphid infestations were localized on terminal branches in the Waihou Spring Forest Reserve on Maui. No mortality could be attributed to the light infestations of this aphid, and it appears that the conifers tolerate this aphid very well.

F-523625

Figure 6.—Release of *Harmonia conformis* (Bois.), a predator of the acacia psyllid.

Monkeypod caterpillar, *Melipotis indomita* (Walker). The monkeypod caterpillar was confirmed primarily to kaiwe (*Prosopis pallida* HBK). Populations remained at moderately low levels, reaching their peak during April and May. An egg parasite, *Trichogramma* sp., may be responsible for suppressing the population at its low levels this year. A tachinid fly, *Eucelatoria* sp., which has shown excellent potential as a biological control agent in the laboratory, was purposely introduced from Mexico by the State Department of Agriculture as a control agent for the monkeypod caterpillar. Several releases were made on Oahu during the past year, but the fly has failed to establish in the field.

Noctuid moth, *Anua indiscriminate* (Hampson). This moth, described from India, Ceylon, and the Philippine Islands, was accidently introduced onto Oahu in June. The moths feed primarily on plants in the family Myrataceae. Caterpillars were detected on common and strawberry guava (*Psidium guajava L.* and *P. cattleianum* Sabine). The moth has not been detected in the forested areas or on the other major Hawaiian Islands. Native ohia and eucalyptus are potential hosts for this noctuid moth.

Status of Diseases—California

Foliage and twig diseases. A wet spring contributed to an increase of foliage and twig diseases on conifers and hardwoods. In the foothills and coastal forests, *Gnomonia veneta* (Sacc. & Speg.) Kleb. was found on sycamore; *Ascochyta hanseni* Ell. & Ev. on madrone; *Colletotrichum gleosporioides* Penz. on California laurel; and *Exobasidium vaccinii-uliginosi* Bond. on rhododendron.

There were also reports of needle cast fungi: a *Laphodermium* sp. on bristlecone fir, Monterey County; *L. durilabrum* Dark. on foxtail pine, Siskiyou County; *Lophodermella arcuata* (Dark.) Dark. on sugar pine, Tuolumne County; *Virgella robusta* (Tub.) Dark. on white fir, Modoc County; and *Sydowia gregaria* Bresdola on white fir, Modoc County. The needle blight fungus, *Elytroderma deformans* (Weir) Dark., was reported on ponderosa and Jeffrey pines in Siskiyou, Shasta, Lassen, Butte, Eldorado, Fresno, and San Diego Counties; this was a significant increase in the observable incidence of this disease.

Root diseases. There were continued reports of root diseases: *Fomes annosus* (Fr.) Cke. on ponderosa and Jeffrey pines in the east side pine type in Trinity, Lassen, Ventura, San Diego, Tuolumne, and Plumas Counties; *Verticicladiella wagenerii* Kend. on Douglas-fir in Mendocino and Humboldt Counties; and *Armillaria mellea* Vahl. ex Fr. on Atlantic cedar and madrone in Santa Cruz County, and on Douglas-fir in Humboldt County.

Stem cankers. A basal trunk canker of western sycamore was observed in plantings in the Mile Square Park of Fountain Valley, Los Angeles County. Isolations from the margins of the necrotic tissue of the cankered areas yielded *Phtophthora cinnomoni* Rands. The western sycamore is a new host for this disease in California.

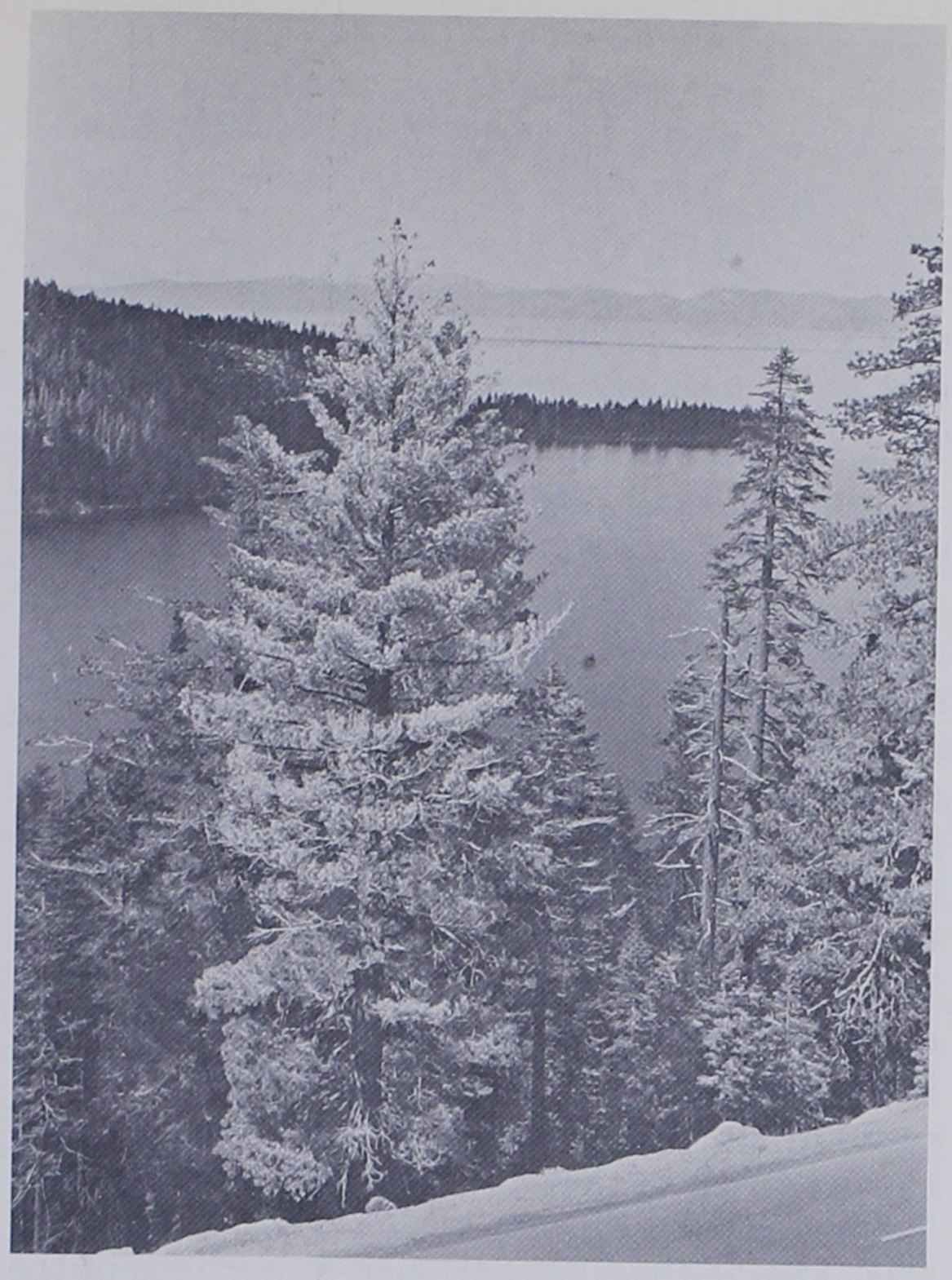

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Figure 7.—The needles of a dying, salt-damaged sugar pine appear pale in comparison to the darker foliage of nearby healthy trees. Three-quarters of the crown of this sugar pine is severely affected by accumulations of salt used for highway deicing; the lower portion of the crown is also damaged, although it retains a greener appearance (Emerald Bay, Lake Tahoe, Calif.).

Nursery diseases. *Botrytis cinerea* Pers. ex Fr. was a problem again in the coast redwoods at the Louisiana-Pacific containerized nursery in Humboldt County. Because some of the *B. cinerea* was resistant to Benlate®, a combination of Botran, Daconil 2787, and Benlate® was used to suppress the disease. *B. cinerea* was found in the Forest Service Humboldt Nursery also, but it caused little damage. Coast redwoods in the Humboldt Nursery were stunted by mycorrhizal deficiency. The roots of healthy seedlings were colonized by *Endogone* spp., but none was found in the roots of stunted seedlings. Other diseases found in the Humboldt Nursery were *Sirrococus strobilinus* (Desm.) Petr., on Jeffrey pines, and *Rosellinia herpetrichoides* Hept. & Davids., on 2–0 Douglas-firs.

Air pollution. The Forest Service began a comprehensive evaluation of smog damage in California forests in 1974, and reported widespread smog damage to ponderosa pines in southern Sierra, Nevada. Slight and scattered damage was reported earlier in these locations, and damaging oxidant levels were recorded in 1974. Prior to this report, general smog effects were thought to be confined to southern California forests. The Forest Service survey crew also found heightened smog damage levels in all of the National Forests in southern California, and reported smog damage at a number of locations thought to be free of this disease.

Weather damage. Snow breakage was a problem in the San Bernardino National Forest, San Bernardino County, and in the Santa Cruz Mountains, Monterey County. In the Arrowhead Ranger District of the San Bernardino National Forest, trees were killed or damaged on 2,000 acres. In northern California, winter injury caused tip damage on ponderosa pine in plantations. The damaged trees were subsequently invaded by secondary twig beetles.

Salt damage. Conifers continued to be damaged and killed near highways deiced with salt in the Lake Tahoe Basin in Eldorado (fig. 7) and Placer Counties.

Status of Diseases—Hawaii

Ohia decline. Ohia decline continued to be the State's most serious forest disease problem. It is estimated that approximately 200,000 acres of ohia forest are now affected with varying degrees of decline ranging from severe to mild. The major decline areas remained localized on the windward slopes of Mauna Kea and Mauna Loa. Questionable ohia decline was noted on Kauai island in the Kokee and Hanalei areas.

Traces of ohia decline were also noted on Molokai island. The Forest Service Institute of Pacific Island Forestry temporarily acquired a forest pathologist to study the ohia decline problem. Emphasis will be placed on determining the extent, severity, and causes of the decline, and on developing and testing methodology to prevent or control the condition.

Insects were collected on declining ohia trees, but the evidence gathered was not conclusive to incriminate them in ohia decline. University of

Hawaii pathologists isolated soil-inhabitating fungi, *Phytophthora cinnamoni* Rands. and *Pithium* sp., in the decline areas. Tests are being conducted to determine their role in ohia forest decline.

Needle cast, *Lophodermium pinastri* (Schrad. ex. Fries) Chevallier. Approximately 300 acres of Monterey and cluster pine are now affected with *Lophodermium pinastri* needle cast on Molokai island. Cluster pine in the Waihou Spring Forest Reserve on Maui is also moderately infested with this needle cast fungus. Drought conditions have no doubt intensified the spread of the disease.

INTERMOUNTAIN STATES (R–4)[4]

by
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Conditions in Brief

Bark beetles continued to be responsible for the greatest loss of timber resources in the Intermountain Region. Mountain pine beetle, Douglas-fir beetle, and Englemann spruce beetle populations are declining, except in some localized areas. Attempts to accelerate a sales program for salvage have been hampered by a sagging lumber economy and low-quality timber.

Defoliators continued throughout Douglas-fir and true fir stands, decreased in ponderosa pine types, and caused limited damage in a variety of coniferous and deciduous types. Western spruce budworm was omnipresent in areas of Idaho and Wyoming. Pine butterfly populations decreased to a point where no visible defoliation could be detected from the air. Top kill, however, an aftermath of defoliation, was evident in localized areas. No new areas of Douglas-fir tussock moth were found. Most stands defoliated in 1973 were observed to be putting on new foliage.

Fomes anosus was found infecting subalpine fir. Scattered branches within the crown of these trees were infected with *Cytospora* sp. The disease was also found infecting ponderosa pine in the Boise Basin Experimental Forest. *Fomes applanatus* was found as an active root rotter of aspen in five campgrounds.

Aspen twig and leaf blight and Rhabdocline needle cast infection levels were at a low point this year, possibly because this was one of the driest years on record.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. Killing of lodgepole, ponderosa, and Jeffrey pine by the mountain pine beetle continued throughout the Region, but considerably below levels of previous years. The outbreaks in the lodgepole forests of southern Idaho and western Wyoming all but ran their course. On the Targhee National Forest, tree killing continued at a high level in the Island Park area and to a lesser extent on the Moose Creek Plateau. A potentially damaging outbreak was in progress in the lower Gros Ventre River of the Bridger-Teton National Forest. Widely scattered but diminishing outbreaks continued in portions of the Caribou National Forest in southern Idaho. During the 1974 aerial survey of the Cassia Division, Sawtooth National Forest, Idaho, heavy fading was observed throughout most of the lodgepole type, which indicates an increasing beetle population likely to continue through 1975.

Overall, stands were of low economic value as sawtimber. Attempts were made to salvage or sell several sales at minimum stumpage, but because of market conditions, little interest was shown by industry.

On the Northern Division of the Sawtooth, the mountain pine beetle remained epidemic in Warm Springs Creek and its tributaries west of Ketchum, Idaho. Also, new attack areas and expansion of old areas were recorded along the North Ford of the Big Wood River from Ketchum to Galena Summit, Idaho. Trees of large diameter were abundant and should provide suitable host material for continued beetle activity. Mountain pine beetle had infested both lodgepole and ponderosa pine stands from McCall, Idaho, southward into Round Valley for approximately 40 air miles. During the past 2 years, new fading was detected in and around McCall, indicating a resurgence of activity in the old Payette River infestation.

[4] Includes forested lands in Utah, Nevada, southern Idaho, western Wyoming, and eastern California.

A chronic infestation in stagnated second-growth ponderosa pine continued to kill trees on private lands southeast of Cascade, Idaho. Until the past 2 years, losses due to mortality were primarily in trees 10 inches d.b.h. and over. Considerable host type remains and the infestation is expected to continue for at least another year.

In portions of the Vernal District, Ashley National Forest, efforts were underway to salvage dead material and to retard the thrust to the infestation by strategic logging. Less serious killing of lodgepole pine continued in widely spaced outbreaks on the Uinta National Forests.

The serious outbreak in ponderosa pine in Bryce Canyon National Park and the adjacent Dixie National Forest was at its lowest level in 10 years. Mixed ponderosa and lodgepole stands were still under attack on the Flaming Gorge Ranger District, Ashley National Forest, but at a reduced rate.

Widely scattered killing of lodgepole, ponderosa, and Jeffrey pine occurred throughout the southern half of the Toiyabe National Forest, Calif. Heaviest activity was in the upper reaches of the East Fork of the Carson River.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Overall, Douglas-fir beetle populations remained low and fairly static throughout the Boise Zone and increased on the Targhee National Forest. Attacks continued in widely scattered areas throughout the Boise, Payette, Salmon, Challis, and Sawtooth National Forests at about the same level as recorded in 1973.

The mature over-mature Douglas-fir stands in a 20-mile bank along the South Fork of the Payette River, incurred losses on the Boise National Forest, Idaho. Helicopter sales were being considered for logging the extremely steep slopes. This type of management should, in a period of a few years, reduce the beetle impact and convert the stand to a more healthy condition.

Engelmann spruce beetle, *Dendroctonus rufipennis* (Kirby). The long outbreak in the upper reaches of Huntington Creek, Manti-LaSal National Forest, Utah, continued to decline. Logging for salvage in a small part of the infestation was planned but momentarily stymied because of inadequate local mill capacity.

Engraver beetles, *Ips* spp. In distinct contrast to the past few years, engraver beetles caused only nominal damage in 1974 to ponderosa pine throughout the Boise Zone. The 1973 lindane chemical spray program in three logging areas on the Boise Forest successfully controlled *Ips* sp. populations.

Contrary to the pine engraver situation in ponderosa pine, *Ips* beetles were taking a heavy toll of small-diameter lodgepole pine in many of the decreasing mountain pine beetle outbreaks. Heaviest tree loss occurred in portions of the Targhee and Bridger-Teton National Forests and Grant Teton National Park.

Western spruce budworm, *Choristoneura occidentalis* Freeman. Although at a relatively low status during 1973, budworm populations increased slightly in 1974, showed up in a few new areas, and should increase in both extent and intensity in 1975. Defoliation predictions made in 1973 for 1974 were accurate for most areas.

Aerial defoliation surveys in 1974 were hampered by an early needle fall from previously defoliated trees, which obscured the full extent of defoliation. Several potentially susceptible areas were not surveyed.

The relatively new infestation that developed around McCall, Idaho, spread southward throughout the Cascade Reservoir area. Egg mass surveys near the Cascade reservoir, West Mountain area, indicated increasing defoliation in 1975. Elsewhere in the Boise Zone, egg mass surveys indicated static to decreasing trends.

Defoliation of Douglas-fir and subalpine fir occurred at the north end of the Targhee National Forest. Some discernible defoliation was observed in other areas of the Targhee and Bridger-Teton National Forests. Heavy egg mass deposition in portions of the Bridger-Teton infestation portends moderate to heavy defoliation of some areas in 1975.

Scenic and recreation areas such as Snow King Mountain overlooking Jackson, Wyo., and portions of the heavily traveled Snake River Canyon will exhibit moderate to heavy defoliation in 1975.

Douglas-fir tussock moth, *Orgyia pseudotsugata* (McDunnough). After a rather dramatic appearance in 1973, encompassing over 11,000 acres, tussock moth damage declined to near zero in 1974, except on some 1,100 acres near Fairfield that required spraying. DDT at three-fourths of a pound per acre suppressed this population. Chronic areas of infestation near Silver City and

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Figure 8.—Defoliation of white fir caused by the white fir needle miner.

South Mountain, Owyhee County, Idaho, did not show any aerially visible damage. However, previously defoliated Douglas-fir stands near Delamar Mountain showed heavy mortality.

White fir needle miner, *Epinotia meritana* Heinrich. The outbreak of this needle miner in white fir, *Abies concolor*, in portions of the Dixie National Forest and Bryce Canyon National Park (fig. 8) continued to decline. Larval populations were virtually nonexistent in 1974. Widely scattered tree mortality and top kill occurred in some areas, but many heavily damaged trees showed signs of recovery.

Pine needle scale, *Phenacaspis pinifoliae* (Fitch). Spraying malathion to control mosquitoes triggered a heavy but small infestation of this scale in Jeffrey pine near Genoa, Nev.

Sawfly, *Neodiprion fulviceps* (Cresson). A very localized infestation on ponderosa pine in Clear Creek, Fishlake National Forest, Utah, has been in progress since 1970. Although populations have been decreasing since 1972, there was sufficient larval feeding to cause heavy defoliation for the fifth consecutive year. No tree mortality had occurred.

Fall cankerworm, *Alsophila pometaria* (Harris). This insect was reported defoliating a variety of hardwoods in Corn Creek, Fishlake National Forest, and in residential areas in the Salt Lake Valley, Utah. The trend of the infestation is unknown.

Status of Diseases

Dwarf mistletoe, *Arceuthobium spp.* The most serious disease of conifer species of the Intermountain Region continued to be dwarf mistletoe. No projects on National Forest land that were financed by Forest Insect and Disease Management were conducted this year. Post-control evaluations of projects spanning a 13-year period revealed a 69- to 90-percent reduction in the number of infected trees per acre.

Anthracnose of ornamental oak, *Gnomonia veneta* (Sacc. & Speg.). The leaves of Gambel oak, *Quercus gambelii*, growing around three homes in Ogden and Farmington, Utah, were examined. These trees, which were found infected with oak anthracnose, were irrigated frequently. Because unirrigated oaks growing wild in the foothills were not diseased, it is assumed that this disease occurred because irrigation during a dry period provided the moisture necessary for infection.

Annosus root rot, *Fomes annosus* (Fr.) Cke. *Fomes annosus* was found infecting subalpine fir on the Mink Creek Road, Wasatch National Forest, and on the Powder Mountain Ski area near Ogden, Utah. Scattered branches within the crowns of these trees were infected with *Cytospora* sp. *F. annosus* was also found in the Boise Basin Experimental Forest killing a sawlog-size ponderosa pine. There were other ponderosa pine dying in this area, but the cause could not be determined.

Appanatus root rot, *Fomes applanatus* (Pers. ex Wallr.) Gill. Examination of dying and windthrown aspen in four campgrounds along the North Fork of the Duchesne River, Uinta National Forest, revealed that the roots of these

trees were being rotted by the fungus *Fomes applanatus*. Crown symptoms observed were leaves less than normal in size and thinning foliage. Some windthrown trees, however, did not exhibit any crown symptoms. A similar condition was found in a campground in Logan Canyon on the Logan Ranger District of the Wasatch National Forest.

Aspen twig and leaf blight, *Marssonina populi* (Lib.) Magn. Regionwide, the incidence of aspen twig and leaf blight was low this year. The most probable cause for a decrease of the incidence of this disease is that one of the driest growing seasons on record occurred in 1974.

Aspen canker, *Cytospora* sp. Aspen cover on the Angel Creek Campground, Wells Ranger District, Humboldt National Forest, was reported dying. A visit revealed that each tree had multiple *Cytospora* cankers girdling the stem, which killed the tree. The trees were growing on a very well drained site. There was much damage, caused by recreationists, to many of the stems, and these wounds acted as infection courts. The prolonged drought during the growing season probably accelerated the rate of dying.

Rhabdocline needle cast of Douglas-fir, *Rhabdocline pseudotsugae* (Syd.). The incidence of the Rhabdocline needle cast was lower this year than in previous years, probably because dry weather conditions during late spring restricted the infection of the new growth.

Air pollution. Two generating stations went into operation in 1973. Both are equipped with electrostatic precipitators that keep the fly ash emissions to a barely discernible plume. Although release of sulfur dioxide is unchecked, vegetation plot examinations around both power plants revealed no damage that could be ascribed to sulfur dioxide.

Other diseases. A dieback of desert ash, *Fraxinus velutina*, in Zion National Park was investigated. The principal problem appeared to be drought. A fungus of the genus *Alternaria*, which is considered a weak parasite or saprophyte on plant material, was isolated from leaves and twigs. The drought conditions probably predisposed the trees to invasion by this organism. Following heavy irrigation of the trees, a new flush of growth occurred in the late summer. Specimens of singleleaf ash, *Fraxinus anomala*, exhibiting brown deposits on the leaves and thinning of the leaves, were found in the Arches National Park. Examination revealed these deposits to be water soluble, and chemical analysis determined that saccharides were present. The deposits were probably a form of aphid honey dew.

NORTHERN ROCKY MOUNTAINS (R–1) [5]

by

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Conditions in Brief

A variety of insects damaged forests in the Northern Region during 1974. The Douglas-fir tussock moth was the target of an aggressive program that included operational spraying of 75,300 acres in Idaho and several pilot control projects using chemical and biological agents. Western budworm defoliation increased and now affects approximately 4.2 million acres of Douglas-fir, true fir, and Engelmann spruce forests. Larch casebarer continued to cause defoliation and tree decline throughout the Region. Western false hemlock looper populations declined in intensity, although the total area of visible defoliation remained about the same. Pine needle sheath miner populations increased in lodgepole pine stands in Glacier National Park and on the Flathead National Forest in Montana. Defoliation intensities were also greater on the Gallatin National Forest in Montana and Idaho Panhandle National Forest in Idaho.

Lodgepole pine stands continued to sustain heavy losses by mountain pine beetle on the Gallatin, Kootenai, and Lolo National Forests in Montana. New infestations developed in lodgepole pine stands on the Beaverhead National Forest and in Glacier National Park. The

[5] Includes forested lands in Montana, northern Idaho, North Dakota, northwestern South Dakota, and National Park Service land in northwestern Wyoming.

massive Yellowstone National Park infestation has stabilized. Second-growth ponderosa pine stands suffered increased losses from mountain pine beetle during the year in Montana. Major infestations occurred on the Bitterroot, Lolo, Helena, and Lewis and Clark National Forests.

Infestations of Douglas-fir beetle declined for the third consecutive year in the North Fork Clearwater River drainage. Pine engraver beetle activity increased in the Northern Region, particularly in Montana, primarily because of drought conditions existing in the Region during 1974. The fir engraver beetle caused tree mortality in grand fir stands on the Nezperce, Clearwater, and Idaho Panhandle National Forests in Idaho, and on the Flathead and Lolo National Forests in Montana.

Sulfur dioxide damage to vegetation was evident near Anaconda, east Helena, and Missoula, Mont. Fluorides continued to cause damage near Columbia Falls, Mont. Substantial deposits of heavy metals were present on vegetation near an antimony smelter at Thompson Falls, Mont.

Root diseases have caused considerable damage in northern Idaho and were more prevalent in western Montana than formerly thought; *Phellinus weirii* and *Armillaria mellea* were the primary causal agents. *A. mellea* was found on roots of a dead juniper—a new host record for Montana. Stem decay was widespread and continued to be a major factor in timber volume losses. Seedling mortality at the Coeur d'Alene Nursery ranged from 1 to 70 percent, depending on species and seed sources. Soil microflora and soil chemical and physical properties are being investigated, and fumigation practices and chemical fungicides are being evaluated at the nursery. About 145,000 western white pine seedlings, resistant to *Cronartium ribicola*, were planted in 1974, the first commercial plantations of genetically improved seedlings in the Northern Region.

Status of Insects

Douglas-fir tussock moth, *Orgyia pseudotsugata* McDonald. The Douglas-fir tussock moth outbreak, which began in the Northern Region in 1970, continued through 1974. Approximately 115,000 acres of Federal, State, and private lands were damaged in northern Idaho in 1974, and an additional 11,150 acres were infested in two areas of western Montana. The increased tussock moth populations during the year resulted in emergency treatment of approximately 87,000 acres in northern Idaho with DDT (fig. 9). A large-scale pilot control project with two microbial materials, *Bacillus thuringiensis* Ber. and a nucleopolyhedrosis virus, was planned for two areas in Idaho totaling 27,000 acres. Pilot control projects of Sevin®-4-oil and *B. thuringiensis* were conducted in localized infestations in Montana.

A total of 75,300 acres were treated, and the DDT effort was successful with an overall target insect mortality of 99.5 percent. Some areas originally designated for treatment were deleted because anticipated epidemic populations did not materialize.

Pilot projects with Sevin®-4-oil and *B. thuringiensis* in Montana were conducted on vigorous tussock moth populations. Approximately 200 acres of privately owned lands were treated with *B. thuringiensis* near Lolo, Mont.; a population reduction of 73 percent was achieved.

Late in 1974, a new outbreak of Douglas-fir tussock moth was discovered in Lake County, Mont., on the Flathead Indian Reservation. Approximately 10,000 acres northwest of Polson, Mont., along the south shore of Flathead Lake, were infested. Three localized spot infestations also occurred in the Jocko River Valley, Mont. Egg mass surveys indicated that sufficient larval populations will emerge to cause additional defoliation in these areas next year.

Western budworm, *Choristoneura occidentalis* Freeman. Western budworm defoliation was detected on 4,180,385 acres in this Region during 1974. This represents an increase of 614,525 acres of visible defoliation over 1973. Greatest defoliation increases were observed in Montana on forested lands east of the Continental Divide, where defoliation increased from 166,530 acres in 1973 to 689,252 acres on the Helena, Deerlodge, Gallatin, and Beaverhead National Forests in 1974. Fall egg mass surveys in these areas revealed an average egg count of 20 per 1,000 square inches of foliage, which should result in about 55 percent of the new shoots being damaged. Continued budworm defoliation on the Flathead National Forest in Montana is resulting in top kill of subalpine fir, Engelmann spruce, and Douglas-fir.

A significant decline in budworm defoliation occurred on the Nezperce National Forest in

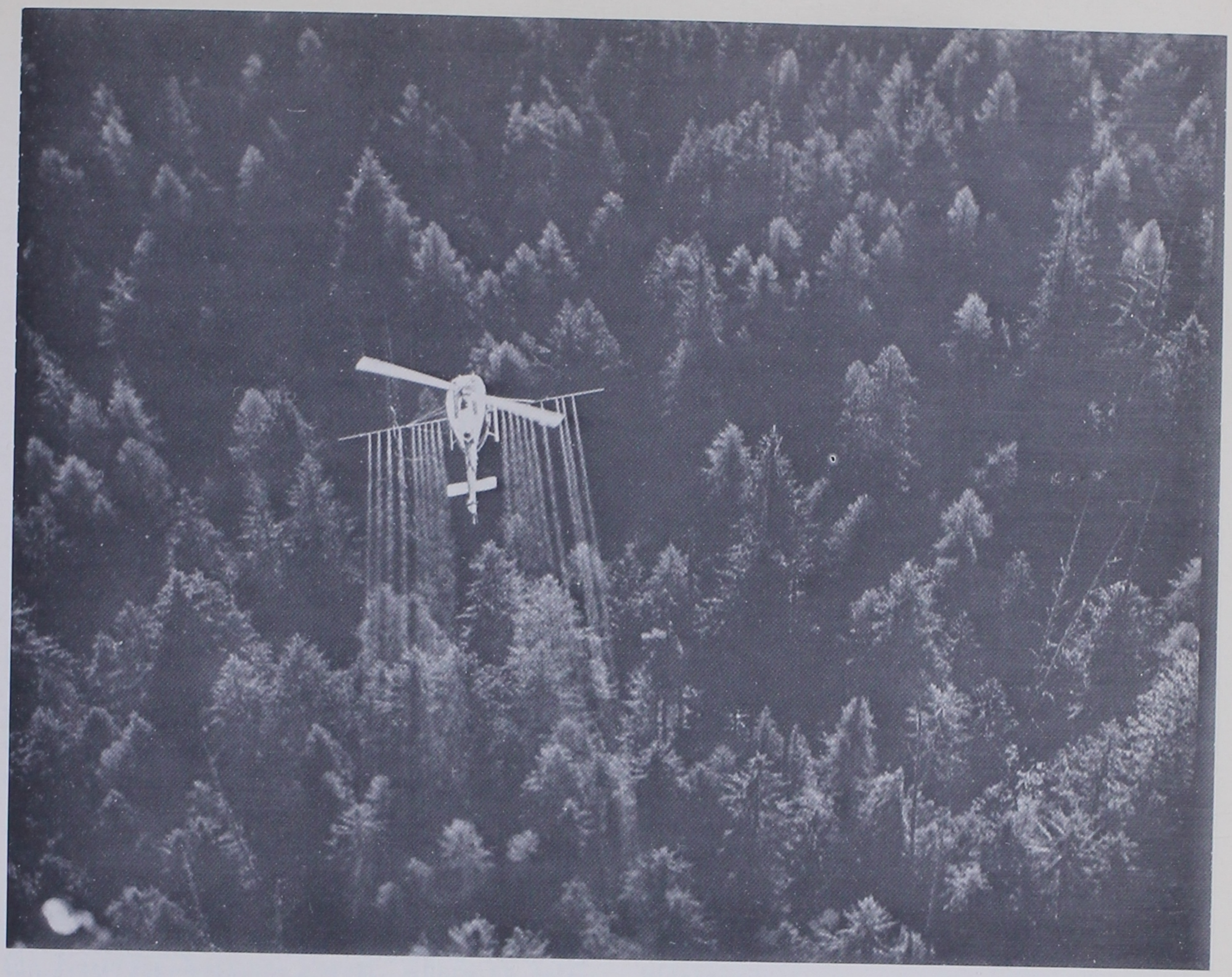

Figure 9.—Douglas-fir tussock moth spray project: helicopter spraying infested plots (Clearwater National Forest, Idaho). F–523627

Idaho, and is attributed to depletion of host type. A significant increase in acres infested and intensity of defoliation in new outbreak areas east of the Continental Divide in Montana is predicted for 1975. A static to slightly increasing situation is expected in western Montana and northern Idaho. A continued downward trend in budworm populations is predicted for the Nezperce National Forest.

Larch casebearer, *Coleophora laricella* (Hbn.). Defoliation by larch casebearer continued during 1974. Foliar damage increased in larch stands on the Flathead, Lootenai, and Lolo National Forests in Montana, and on the Idaho Panhandle and Clearwater National Forests in Idaho.

Two new imported parasitic wasps were introduced into infested larch stands near Evaro, Mont., in a continuing effort to establish efficient biological control agents. A total of 745 *Necremnus metalarus* (Walker) and 112 *Elachertus argissa* (Walker) was released in selected stands. During 1974, additional releases of the parasite *Chrysocharis laricinellae* (Ratz.) were made.

Western false hemlock looper, *Nepytia freemani* Munroe. Infestations of this defoliator declined during 1974. The area of visible defoliation was about the same as during 1973 (approximately 3,000 acres), but intensities of looper damage decreased considerably. Several natural parasites; a tachinid, *Cermoasia auricaudata* Tns.; and two ichneumonids, *Phobocampe* sp. and

Apechthis sp., were observed in the fall of 1973 and may have been responsible for suppressing looper populations during 1974.

Pine needle sheath miner, *Zelleria haimbachi* (Busck). Damage caused by the pine needle sheath miner continued in the Northern Region during 1974. Defoliation intensity and areas of infestation increased on the Gallatin, Flathead, and Idaho Panhandle National Forests. Moderate to heavy defoliation of current year's growth occurred on approximately 57,500 acres of lodgepole pine between Martin City, Mont., and Lake McDonald, Glacier National Park. Heavy defoliation occurred on 28,700 acres on the Flathead National Forest, and approximately 1,200 acres were moderately defoliated on the Gallatin National Forest. A new area of activity developed on the Idaho Panhandle National Forest in Idaho. Approximately 15,000 acres of private lands were heavily damaged at Rathdrum Prairie, about 7 miles north of Coeur d'Alene, Idaho.

In Montana, populations of pine needle sheath miner are often associated with infestations of the sugar pine tortrix, *Choristoneura labertiana* (Busck). In 1974, however, *C. lambertiana* populations remained at low levels, while *Z. haimbachi* populations were responsible for visible damage. Parasite collections at Rathdrum Prairie, Idaho, and near Martin City, Mont., indicated that two parasites, an ichneumonid, *Chelonus (Microchelonus) acutiguster* McComb, and two chalcids, *Spilochalcis albiforns* (Walsh) and *Spilochalcis leptes* Burks, are exerting some control against *Z. haimbachi* populations. Infestations of *Z. haimbachi* are expected to continue at their present high level, with a possible increase in acreage and intensity of defoliation during 1975.

Mountain pine beetle, *Dendroctonus ponderosae* Hopkins. Mountain pine beetle continued as the number one bark beetle pest. Tree mortality increased in both lodgepole and ponderosa pine stands on forests east and west of the Continental Divide and in Glacier National Park, Mont. A decline in activity occurred in lodgepole pine stands in Yellowstone National Park, Wyo. Pine beetle activity also declined in western white pine stands in northern Idaho.

In the Gallatin River drainage, south of Bozeman, Mont., the number of lodgepole pine killed in 1974 was four times greater than in 1973, and an estimated 81,000 trees on 5,200 acres (a volume of 1,500,000 board feet) were infested in 1974. Infestations intensified in lodgepole pine stands on the Hebgen Lake Ranger District, Gallatin National Forest, Mont. New outbreaks of mountain pine beetle developed in mature and overmature lodgepole pine stands on the Beaverhead National Forest in Montana. Over 1,800 infested trees on about 780 acres exist east of Ennis, Mont. Infestations expanded in mixed lodgepole pine stands in the Yaak River drainage, Kootenai National Forest, Mont. An increase in tree and volume losses is predicted for this area in 1975.

The massive Yellowstone National Park infestation reached a static condition. About 1,845,000 lodgepole pine trees on approximately 275,000 acres were infested in 1974.

Epidemic conditions occurred in mixed lodgepole pine stands on approximately 4,630 acres in Glacier National Park, Mont. Survey data indicate a 1:10 buildup ratio in the number of infested trees from 1973 to 1974. About 178,700 trees are currently infested, and this outbreak is expected to intensify in 1975.

Mountain pine beetle infestations in mature to overmature and second-growth ponderosa pine stands have increased in the Region. Areas of greatest infestation occur on the Bitterroot, Helena, Lolo, and Lewis and Clark National Forests. Approximately 100 acres of newly infested trees were found on Bureau of Indian Affairs and private lands on the Crow Indian Reservation in eastern Montana.

In white pine stands in northern Idaho, mountain pine beetle activity decreased in 1974. Localized group kills occurred on the Clearwater and Nezperce National Forests in Idaho.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins. The massive outbreak of Douglas-fir beetle in the North Fork Clearwater River drainage, Idaho, declined for the third consecutive year. Groups of infested trees were widely scattered and significantly smaller than in previous years. Brood sampling revealed a reversal in the trend of brood to adult ratios. As a result of the turnaround in ratios, a larger beetle flight may occur, resulting in increased tree attack and infestation spread during 1975.

Pine engraver beetles, *Ips* spp. The extremely dry year that prevailed in 1974 resulted in increased *Ips* activity in northern Idaho and Montana. More than 1,400 trees were killed by *Ips* spp. on the Lolo National Forest, and an estimated 600 trees were killed on the Bitterroot National Forest.

Epidemic populations of *Ips* developed on approximately 550 acres near Edgemere, on the Idaho Panhandle National Forest. Buildup in this area resulted from slash left following stand thinning. Chipping and commercial thinning are now in progress to remove infested trees and to improve stand vigor.

Approximately 2,200 ponderosa pine were killed by *Ips* spp. on the Flathead Indian Reservation between Evaro and Perma, Mont. Localized infestations were also detected along the east shore of Flathead Lake near Elmo, Mont.

In Idaho, scattered infestations of *Ips* occurred near the Farragut wildlife management area. Approximately 170 ponderosa pine were killed near Pleasant View, Idaho. Localized killings of lodgepole pine occurred near Cocolalla, Vay, and Blanchard, Idaho.

Fir engraver beetle, *Scolytus ventralis* LeConte. Tree mortality caused by the fir engraver beetle increased in grand fir stands on the Nezperce and Idaho Panhandle National Forests in 1974. Most severe tree mortality occurred on the Nezperce National Forest, where an estimated 17,000 trees were killed on 20,000 acres. In the Idaho Panhandle National Forest, over 8,000 trees were killed on 7,400 acres. The Clearwater National Forest salvage logged over 800,000 board feet of timber to reduce potential losses by this beetle.

In Idaho, scattered infestations persisted near Kamiah, Rathdrum, Coeur d'Alene and Cataldo, and near Priest and Spirit Lakes. Isolated infestations developed on the Flathead and Lolo National Forests in Montana.

Other insects. A defoliating weevil, *Magdalis gentilis* LeC., damaged approximately 700 acres of precommercially thinned lodgepole pine on the Lewis and Clark National Forest (fig. 10). The forest tent caterpillar, *Malacosoma disstria* Hbn., defoliated several species of hardwoods in river basins. An active infestation of the ash borer, *Podosesia syringiae fraxini* (Lugger), damaged shelter belt plantings of green ash in southwestern North Dakota. Economic losses occurred in Christmas tree production areas because of damage caused by the Douglas-fir needle miner, *Contarinia* sp. The lodgepole terminal weevil, *Pissodes terminalis* Hopkins, killed approximately 40 acres of ponderosa pine on the Colville National Forest, Wash. A heavy infestation of the pine needle scale, *Phenacaspis pinifoliae* (Fitch), was found in nearly 00 acres of lodgepole pine on Helena National Forest, near Elliston, Mont.

Status of Diseases

Root diseases. Data collection of a root disease impact survey was completed this year in north Idaho on 20,000 acres (376 stands). Preliminary results showed that: about one-third of the stands had root disease centers with area affected ranging from less than 1 to over 70 percent; in stands with root disease centers, 17 percent of the total area was involved in the centers; over all stands

F-523628

Figure 10.—Examining lodgepole pine for a defoliating weevil, *Magdalis gentilis* LeC. (Lewis and Clark National Forest, Mont.).

F-523629

Figure 11.—Root disease center, caùsed by *Armillaria mellea* and covering 19 acres.

surveyed, 6 to 7 percent of the total area was occupied by root disease centers; and causal agents were primarily *Phellinus weirii* (Murr.) and *Armillaria mellea* Vahl ex Fr.

Armillaria mellea root disease centers (fig. 11) are more frequent in western Montana than formerly thought. Several innfection centers were found near Seeley Lake and Lincoln. In one center, *A. mellea* was found on roots of dead *Juniperus scopulorum* Sarg., a new host record for the State.

Mature sporophores of *Fomes annosus* (Fr.) Cke. were found on dead roots of ponderosa pine near Hot Springs, Mont. The fungus was recovered from these trees in 1973.

Stem decays. Stem decay was widespread and continued to be a major factor in timber production. Broken tops of western larch in a young stand on the Idaho Panhandle National Forests were quite evident. Dissections of these trees showed small decay columns originating from the broken tops. *Stereum sanguinolentum* (Alb. & Schw. ex Fr.) Fr., a common stem decay pathogen, was isolated from decay columns.

Dwarf mistletoe, *Arceuthobium* spp. Data from growth-impact plots of *Arceuthobium americanum* Nutt. ex Engelm. in lodgepole pine indicated that stocking density plays a much larger role in tree growth than light or intermediate dwarf mistletoe infection. An economic analysis of dwarf mistletoe control shows a benefit/cost ratio of 3.21:1 in Douglas-fir and western larch, and 2.42:1 in lodgepole pine. Approximately 4,000 acres of dwarf mistletoe control was accomplished.

Nursery diseases. Seedling mortality, apparently due to root pathogens, *Fusarium* spp., was abundant at the Coeur d'Alene Nursery. Seedling mortality was highly variable among species, among seed sources, and among beds of a given seed source. Losses in 1–0 stock were greatest in

Figure 12.—Fumes from a copper smelter at Anaconda, Mont., have virtually eliminated coniferous forests up to 15 miles distant. F–523630

grand fir, Douglas-fir, and western larch, and least in Engelmann spruce and the pines.

Fumigation of nursery beds has been a routine practice for several years, but soil sampling data suggested that some beds were not being properly fumigated. Tests with benomyl [methyl 1= (butylcarbamoyl) =2= benzimidazolecarbamate], applied at two rates on two dates, were ineffective in reducing mortality in 2–0 Engelmann spruce.

Needle casts. *Rhabdocline pseudotsugae* Syd. caused moderately severe and widespread but spotty defoliation of Douglas-fir in northern Idaho and western Montana. Minor amounts of defoliation caused by *Hypodermella laricis* Tub. were found on individual western larch trees. A fungus tentatively identified as *Lophodermella montivaga* (Petr.) Dearn. was associated with needle damage to lodgepole pine on a small area of the Gallatin National Forest. *L. concolor* (Dearn.) Darker caused widespread and locally heavy defoliation of lodgepole pine in the Clark Fork River drainage, approximately 20 miles on either side of the Idaho-Montana border.

Air pollution. A copper smelter at Anaconda, Mont., reportedly emits nearly 750 tons of sulfur dioxide into the air each day. Typical sulfur dioxide damage was found on Douglas-fir, ponderosa pine, and limber pine. Much of the land around the smelter formerly supported an extensive coniferous forest, but a 10- to 15-mile radius has been denuded (fig. 12). Vegetation on more than 50,000 acres of National Forest, State, and private lands showed varying degrees of sulfur dioxide damage in the Anaconda area.

A sulfur complex consisting of hydrogen sulfide, mercaptans, and sulfur dioxide emitted from a pulp and paper mill at Missoula, Mont., con-

tinued to cause damage to Douglas-fir and ponderosa pine. Although the damage was not as severe in 1974 as in 1972–73, vegetation on more than 2,000 acres of private, State, and Federal land showed symptoms of sulfur damage.

Fluorides continued to be a serious problem near an aluminum reduction plant at Columbia Falls, Mont. Injury to current-year plant tissue was found on lodgepole pine, western larch, and herbaceous indicator plants up to 5 air miles from the aluminum plant. An epidemic insect infestation of a needle sheath miner, *Zellaria haimbachi* (Busck) and a needle miner, *Ocnerostoma strobivorum* (Zeller) was statistically related to ambient and foliar fluoride concentrations in lodgepole pine in the polluted area.

Analysis of vegetation near a small antimony smelter south of Thompson Falls, Mont., revealed substantial amounts of heavy metal deposits on conifer foliage. Antimony is very similar to arsenic in toxicological properties and could pose a serious threat to animal life in the fallout area.

Other diseases. Drought injury to ornamental Engelmann spruce was noticed in several locations throughout the Region. Cottonwood, *Populus* spp., and maple, *Acer* spp., defoliation near Missoula, Mont., was found to be caused by the misuse of the herbicide Atrazine. Spruce broom rust, *Chrysomyxa arctostaphyli* Diet, and western gall rust, *Endocronartium harknessii* (J.P. Moore) Hirtasuka, were noticeable in several areas in the Region.

CENTRAL ROCKY MOUNTAINS (R–2) [6]

by

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Conditions in Brief

Bark beetles continued to be the most destructive insect pest in this Region. The mountain pine beetle epidemic in ponderosa and lodgepole pine stands in Colorado killed more than 470,000 ponderosa pines in the Black Hills of South Dakota this year. This trend is expected to continue. Integrated suppression programs are being conducted against these forest pests. Moderate defoliation activity occurred in widely scattered areas of the Region. The degree of defoliation is predicted to continue at the same level in 1975 as in past years.

Lodgepole pine dwarf mistletoe infestations in the residual overstory resulted in new infections in the regeneration of cutover stands. Overstory removal and stand sanitation were recommended as the best suppression measures. The relative impact of southwestern dwarf mistletoe on ponderosa pine increased because of the urbanization of the Colorado Front Range. Comandra rust in lodgepole pine forests continued to cause losses in Wyoming, and new centers of white pine blister rust on limber pine were discovered in southeastern Wyoming. Dutch elm disease continued to spread in the Region, whereas oak wilt appeared to have reached a state of equilibrium.

Shoestring root rot and black strain rot were major causes of mortality in pine stands. Needle blight caused foliage damage in Christmas tree plantations and windbreaks.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* (Hopk.). This beetle continued to be the most destructive pest in the Region, killing both ponderosa pine and lodgepole pine. The heaviest losses were in the Black Hills of South Dakota and Wyoming and along the Front Range in Colorado.

Losses in the Black Hills (fig. 13) have been occurring for more than a decade with no immediate decrease foreseen. Tree losses in 1974 were in excess of 470,000 trees, with most losses in second-growth stands where the basal area was 150 square feet or more. The major effort of suppression was of an accelerated program of timber sales; close to 400,000 infested trees were removed from the forest in 1974.

Large scale losses of ponderosa pine occurred along the Front Range of Colorado from Colorado Springs to the Wyoming border. Losses also occurred near Buena Vista and Wet Mountain Valley in the Pike-San Isabel National Forest. The Front Range stands were characterized by poor

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[6] The following organizations contributed information for this report: Cooperative Extension Services of Kansas, Nebraska, and South Dakota; South Dakota State Division of Forestry; Wyoming State Department of Agriculture; Colorado State Forest Service; and the Rocky Mountain Forest and Range Experiment Station.

Figure 13.—Mountain pine beetle infested trees in unthinned stands, compared to a noninfested thinned stand (South Dakota). F–523631

sites, dwarf mistletoe, and overstocking. Urban development and intermingled ownership have complicated suppression effects.

Lodgepole pine losses continued in the Middle Park area of Colorado and in the Medicine Bow National Forest in southern Wyoming. Infested trees were on National Forest, Bureau of Land Management, Rocky Mountain National Park, and private lands. Accelerated tree harvest on Bureau of Land Management land and Medicine Bow National Forest reduced these losses.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). Spruce beetle activity was down throughout the region in 1974. A potential spruce beetle problem on the Dolores District of the San Juan National Forest existed where approximately 3 million board feet of spruce windthrow

occurred in May 1974. A salvage sale program was initiated to remove much of the windthrow.

Douglas-fir beetle, *Dendroctonus pseudotsugae* (Hopk.). Minor losses due to this beetle occurred in scattered areas throughout the Region, Generally, mortality occurred in small groups on steep, rocky drainages.

Western spruce budworm, *Choristoneura occidentalis* (Freeman). Budworm, a perennial defoliator of fir and spruce in Colorado, caused generally light defoliation in 1974. Moderate defoliation occurred on less than 10,000 acres, a slight increase over 1973. Light defoliation is predicted for 1975. Some damage to Christmas tree plantations was reported.

Pine tortrix, *Choristoneura lambertiana ponderosana* (Obraztsou). This insect continued to defoliate ponderosa pine along the St. Vrain and Big Thompson Canyons of the Arapaho-Roosevelt National Forest, and on the San Juan National Forest.

Douglas-fir tussock moth, *Orgyia pseudotsugata* (McD.). This moth continued to be a problem on ornamental plantings of blue spruce along the Front Range from Denver to Colorado Springs. Plantings at Lowry Air Force Base, Denver, suffered severe top defoliation, and some top mortality is expected in 1975.

Lodgepole terminal weevil, *Pissodes terminalis* (Hopp.). This weevil, present in the Routt, Arapaho-Roosevelt, and Medicine Bow National Forests, attacks lodgepole pine saplings. Damage was down from the past 2 years.

Tip moths, *Rhyacionia* spp. *R. frustrana* (Comst.), *R. bushnelli* (Busck), and *R. neomexicana* (Dyer) continued to plague shelterbelt plantings on the Plains. Pine planted on severely disturbed soils showed the greatest susceptibility to attack. Surveys in several ponderosa pine provenance studies indicated that the low elevation eastern plains seed sources are less susceptible to attack by tip moths than the other ecotypes of ponderosa pine.

Zimmerman pine moth, *Dioryctria zimmermani* (Grote). This moth is causing an increasing amount of damage to hard pines in north-central Nebraska. Girdling of stems in several windbreaks may prevent an effective wind barrier for the current plantings. Other infested plantings are of such high tree density that some tree loss would probably be beneficial in the long run. At Sioux Falls, S. Dak., another *Dioryctria* sp. is attacking Black Hills spruce planted in landfill.

Needle miners. *Epinotia meritana* (Hein.), continues to infest about 6,500 acres in the North LaVeta Pass area of Colorado (fig. 14), but defoliation in 1974–75 will probably be light. The spruce needle miner *Taniva albolineana* (Kft.) caused light damage in Natrona County, Wyo. Damage from this insect also occurred in the Kansas counties of Douglas, Franklin, Johnson, and Brown.

Aspen leaf miner, *Phyllocnistis populiella* (Chamb.). High populations were present for the second year on aspen in the Black Hills. Long-term damage is believed to be negligible.

F–523632

Figure 14.—White fir stand showing the typical bleached foliage caused by the white needle miner (Colorado).

Other insects. The outbreak of red-humped oakworm, *Symmerista canicosta* (Franc.), in the Newton Hills State Park, S. Dak., collapsed in the spring. Egg density was low, and egg parasitism was about 90 percent. Light populations of the walnut caterpillar, *Dantana integerrima* (G&R), were present on walnut in the Newton Hills State Park, and also occurred in light numbers in eastern Kansas on black walnut plantings. Populations of spring cankerworm, *Paleacrita vernata* (Peck), and fall cankerworm, *Alsophila pometaria* (Harr), infested many shelterbelts on the Plains. This insect was common in the southern half of South Dakota. Severe defoliation occurred in the Kansas counties of Finney, Barton, and Riley.

The elm leaf beetle, *Pyrrhalta luteola* (Muller), defoliated elms in South Dakota, Kansas, and Nebraska. Members of the genus *Malacosoma* caused heavy defoliation of chokecherry in wildlife production areas in Bonhomme County, S. Dak. The pine butterfly, *Neophasia menapia* (Feld and Feld) caused light defoliation in the Keystone area of the Black Hills of Wyoming and along the Front Range of Colorado. Pitch nodule moth, *Petrova arizonensis* (Heim.), damage on pinyon on the Upper Arkansas River Drainage was lower than in past years. An unidentified species of *Petrova* caused forked tops in the ponderosa pine seed orchard in the Dolores District, San Juan National Forest. The pine shoot moth, *Eucosma sonomama* (Kearf.), continued to damage young pines in the San Juan National Forest.

Status of Diseases

Dwarf mistletoe, *Arceuthobium* spp. The southwestern dwarf mistletoe, *A. vaginatum* subsp. *cryptopodum* (Engelm.) Hawks. and Wiers, caused pockets of tree mortality on 310,000 acres of commercial ponderosa pine forests in Colorado, particularly in the Pike-San Isabel and Roosevelt National Forests. A detection survey in the Laramie Mountains of Wyoming revealed three large pockets of dead limber pine, up to 10 acres in size, that were caused by limber pine dwarf mistletoe, *A. cyanocarpum* (Colv. & Nels.) Over 25,000 acres of lodgepole pine were surveyed for dwarf mistletoe in the Ball Mountain area of the Red Feather Ranger District, Roosevelt National Forest. Another evaluation survey was conducted in infested lodgepole pine in the Cebolla District of the Gunnison National Forest. With use of these data in the LPMIST [7] computer program, management alternatives can be provided. Recent estimates showed that 50 percent of the lodgepole pine stands in the Region were infected by *A. americanum* (Nutt. ex Engelm.).

Rusts. The most economically important rust in the Rocky Mountain Region was Comandra blister, *Cronartium comandrae* Pk., which damaged lodgepole pine forests on the Routt, Medicine Bow, and Roosevelt National Forests. The greatest impact of the disease occurred in the Bighorn and Shoshone National Forests in Wyoming, where an estimated 300,000 acres of commercial forest were affected (fig. 15).

A detection survey in southern Wyoming revealed several new infection centers of white pine blister rust, *Cronartium ribicola* Fisch., on limber pine scattered over approximately 1,000 acres in the Laramie Mountains of Wyoming. The survey indicated that the disease was intensifying.

Fir broom rust, *Melampsorella caryophyllacearum* Schroet., on white fir is widespread in the San Juan, Gunnison, and San Isabel National Forests. It was estimated that on the San Juan National Forest 100 percent (nearly 220,000 acres) of the white fir type was infested by this parasite.

Dutch elm disease. *Ceratocystis ulmi* (Buism.) C. Mor. is the most destructive vascular wilt disease, with the major host in this Region being American elm. This disease, which is found in natural stands of elm in Kansas, Nebraska, and South Dakota, has caused over 60 percent loss of trees along river bottoms. In these stands, the disease has already reached its maximum level, and the problem now is dead tree removal. In urban areas, losses are being minimized through active community forest programs of prompt identification and removal of forest trees. A serious epidemic at Fitzsimmons Army Hospital in Denver (fig. 16) will result in the eventual removal of all American elms on the grounds.

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[7] Meyers, C.A., F.G. Hawksworth, and J.L. Stewart. 1971. Simulating yields of managed dwarf mistletoe infested lodgepole pine stands. USDA For. Serv. Res. Pap. RM–72, 15 pp.

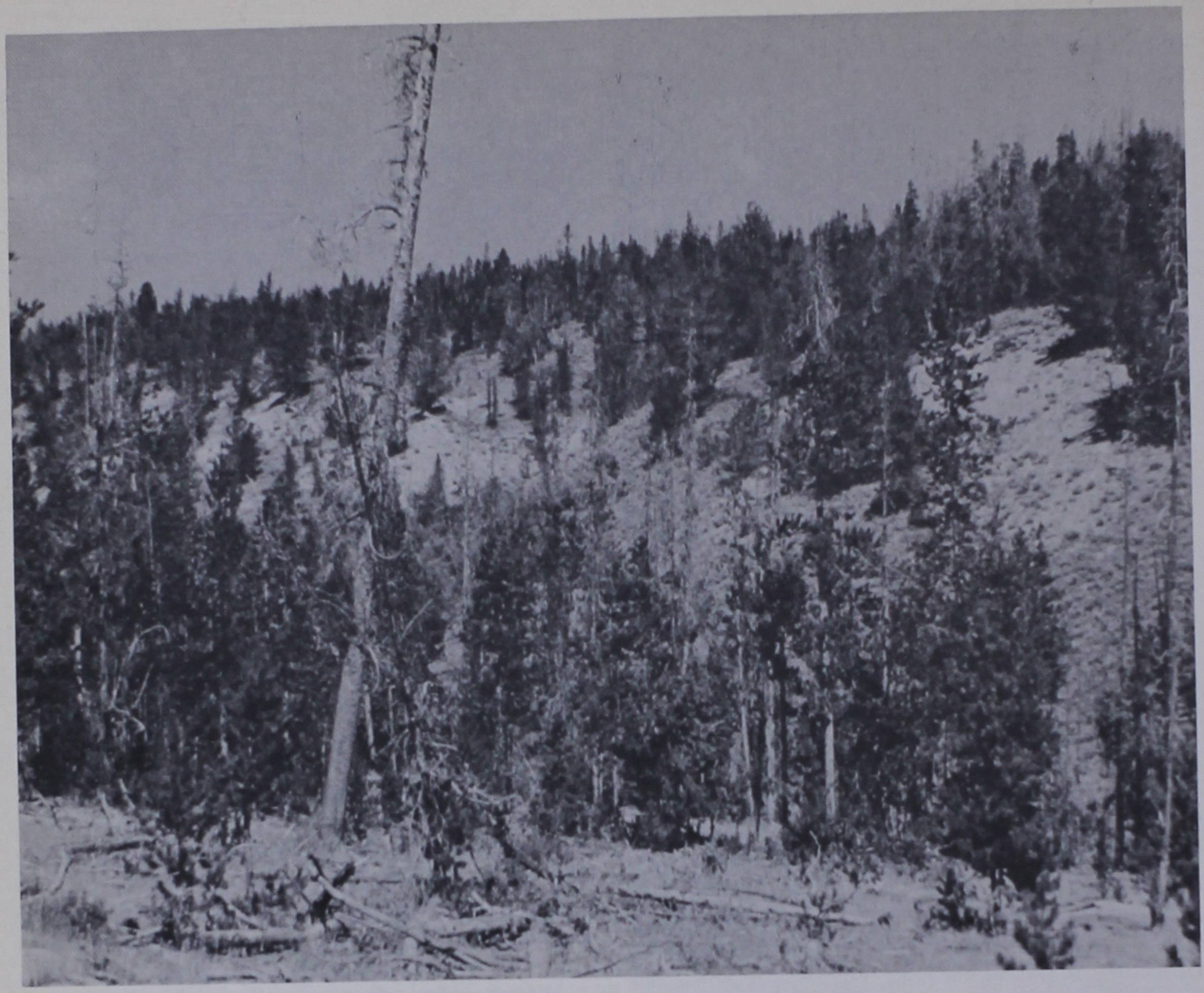

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Figure 15.—Comandra blister rust caused a severe impact on this lodgepole pine stand (Shoshone National Forest, Wyo.).

Oak wilt, *Ceratocystus fagacearum* (Bretz) Hunt. The spread of this disease has apparently reached a state of equilibrium in the oak stands of Nebraska and Kansas. New infection centers (one approximately 5 acres in extent) have been found in Indian Caves State Park in southeastern Nebraska and in several eastern counties of Kansas. Most of these infection centers are spreading slowly because of resistance in the native oaks and unsuitable climate.

Shoestring root rot, *Armillaria mellea* (Fr.) Karst. Stocking in a reproduction spacing study in the Black Hills National Forest, S. Dak., was severely reduced by this disease.

Black stain root rot, *Verticicladiella wageneri* (Kend.). This disease was responsible for pockets of mortality in pinyon stands in Mesa Verde National Park and on the San Juan and Grand Mesa-Uncompahgre National Forests, and recently became a problem in suburban housing developments.

Foliage diseases. Needle blight damage to planted pine was reported from Christmas tree plantations and windbreaks in Kansas and Nebraska. Brown spot, caused by *Scirrhia acicola* (Dearn) Siggers, affected ponderosa and Scots pine *(P. sylvestris* L.), whereas *Dothistroma pini* Hulb. damaged Austrian pine (*P. Nigra* Ar-

F–523634

Figure 16.—Three American elm trees killed by Dutch elm disease in 1 year (Fitzsimmons Army Hospital, Denver, Colo.).

nold). Tip blight caused by the fungus *Diplodia pinea* (Desm.) Kickx. caused serious damage to lateral buds and shoots in Austrian, ponderosa, and Scots pines in Kansas, Nebraska, and South Dakota.

Other diseases. Aspen decline was observed in many recreation areas in Colorado, and severe mortality was especially noted in the popular Maroon Lakes campground near Aspen (fig. 17). Studies showed that the causal agents were canker fungi, notably *Cenangium singulare* (Rehm.) Davids. & Cash, and *Cytospora chrysosperma* (Pers.) F. Although these fungi were responsible for the actual mortality, the aspen are usually predisposed to disease by camper abuse. Severe dieback and mortality of Siberian elm in shelterbelts and other plants in the Plains were caused by a canker fungi, *Botryodiplodia hypodermia* (Sacc.) Petr. & Syd.

SOUTHWESTERN STATES (R–3) [8]

by

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Conditions in Brief

Bark beetles continued as the most destructive group of insects in the Southwestern Region. Severe drought conditions during the winter, spring, and early summer months weakened and killed ponderosa pine trees throughout the Region, providing favorable conditions for buildups of secondary bark beetles. Widespread outbreaks of pine engraver beetles occurred on the Apache-Sitgreaves, Prescott, and Tonto National Forests, Ariz. and on the Cibola and Lincoln National Forests, N. Mex. The roundheaded pine beetle caused scattered mortality of pole-size ponderosa pine in the Lincoln National Forest and Mescalero-Apache Indian Reservation, N. Mex., but heavier tree losses are predicted for 1975. Many sawtimber-size ponderosa pines were killed by the western pine beetle in the Region. A mountain pine beetle outbreak in ponderosa pine continued to increase on the Kaibab National Forest, Ariz. Engelmann spruce beetle infestations declined for the second year.

Defoliating insects attacked conifers and aspen in portions of the Region, but damage was minimal. There were localized increases in western spruce budworm defoliation in northern Arizona and New Mexico. Ornamental spruce, white fir, and Douglas-fir trees were defoliated by the Douglas-fir tussock moth in Santa Fe, Ruidoso, and Los Alamos, N. Mex. The efficacy of ground application of *Bacillus thuringiensis* was tested against the Douglas-fir tussock moth; excellent control was achieved.

The most important disease agents were the dwarf mistletoes. Treatment for the prevention and suppression of mistletoes was limited to commercial stands and high priority recreation areas. Noncommercial stands were not treated.

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[8] Includes all forested lands in Arizona and New Mexico, and National Park Service land in western Texas.

F-523635

Figure 17.—Aspens killed by *Cytospora* cankers after trunks were damaged by camper abuse (San Isabel National Forest, Colo.).

In general, the incidence of mistletoe is lower in forests of the Region that have a high ratio of commercial to noncommercial stands. The status of mistletoes on noncommercial forested acreage is uncertain. Air pollution damage to forest vegetation was not apparent in New Mexico or Arizona.

Status of Insects

Ips beetles, *Ips* spp. These bark beetles caused severe local and widespread mortality of ponderosa pine on the Apache-Sitgreaves, Prescott, and Tonto National Forests, Ariz., and on the Cibola and Lincoln National Forests, N. Mex. Several species were involved, but the Arizona five-spined *Ips*, *Ips lecontei* Sw., and the pine engraver, *Ips pini* (Say), created the greatest problems. Severe drought conditions during the winter, spring, and early summer months killed and weakened trees, making them highly susceptible to attack. Ponderosa pine stands on dry, rocky ridgetops or on deep, droughty soils were most commonly affected. Stand disturbances

from logging and fire also created ideal conditions for beetle population buildup in some areas. A suppression project on the Crown King Ranger District, Prescott National Forest, Ariz., effectively reduced *Ips* populations in and adjacent to 100 acres of highly developed recreation facilities in Horsethief Basin.

Roundheaded pine beetle, *Dendroctonus adjunctus* Blandf. This insect continued to kill small diameter, relatively nonvigorous ponderosa pine trees on and near the Lincoln National Forest and Mescalero-Apache Indian Reservation in southern New Mexico. Even though tree losses were light in 1974, there is some concern that populations may increase as a result of the extensive amount of drought-killed ponderosa pine that is currently available. Historically, roundheaded pine beetle activity increased when drought-killed trees wer present.

Western pine beetle, *Dendroctonus brevicomis* LeC. This insect greatly increased its activity throughout the ponderosa pine forests of the Southwest. Many scattered sawtimber-size trees were killed on the Apache-Sitgreaves, Prescott, and Tonto National Forests in central Arizona and on the Lincoln National Forest in southern New Mexico. This pest was found by itself and in association with the red turpentine beetle, *D. valens* LeC., the Mexican pine beetle, *D. parallelocollis* Chapuis, and *Ips* spp. Drought conditions during the first half of 1974 are thought to be responsible for the increase of these normally secondary beetles.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. In 1974, approximately 4,750 ponderosa pines were killed by this beetle within a 4,500-acre area on the Kaibab National Forest, south of Jacob Lake, Ariz. The infestation developed within a timber sale area, and it was hoped that the outbreak could be suppressed through removal of currently infested trees prior to the beetle flight. The trees, however, were not removed, and new attacks were observed in the sale area and in adjacent stands. A stand cruise conducted in the sale area in September 1974 indicated that the infestation had increased from about 1.9 trees per acre in 1973 to 4.5 trees per acre by fall 1974.

In northern New Mexico, widely scattered ponderosa pine mortality was detected on the Penasco, Taos, and Tres Piedras ranger Districts, Carson National Forest. These infestations have caused scattered losses for several years, and a similar static trend was forecast for 1975. Sanitation-salvage logging was recommended.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). A longstanding outbreak in Engelmann spruce stands on the Fort Apache Indian Reservation, Ariz., continued to decline for the fourth consecutive year. Subzero temperatures, which occurred during the winter of 1971, apparently initiated the decline.[9] A few trees were killed in 1974, but further losses are not expected.

On the San Francisco Peaks, Coconino National Forest, near Flagstaff, Ariz., a spruce beetle population that had been building up in avalanche-damaged spruce was suppressed. Treatment was accomplished by removing bark from infested trees and stumps and by burning some of the infested material. Only widely scattered tree losses were detected elsewhere in the Region.

Western spruce budworm, *Choristoneura occidentalis* Free. A slight increase in budworm activity was detected throughout the Region in 1974. Light to moderate defoliation of Douglas-fir and white fir occurred in Arizona on the Kaibab Plateau. In New Mexico, light to moderate defoliation was detected on State and private lands east of Eagle Nest; on the Carson National Forest, east of Taos; on the Sandia Mountains, east of Albuquerque; and near the New Carrisa Lookout, Lincoln National Forest. Only light defoliation on these forests is forecast for 1975.

Douglas-fir tussock moth, *Orgyia pseudotsugata* McD. Ornamental spruce, white fir, and Douglas-fir trees were defoliated again in the cities of Santa Fe, Ruidoso, and Los Alamos, N. Mex., and infestations in and near all three cities increased over the 1973 level. The outbreaks are expected to decline in 1975. The efficacy of ground application of *Bacillus thuringiensis* with a hydraulic sprayer was tested in Santa Fe.

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[9] Frye, R.H., H.W. Flake, and C.J. Germain. 1974. Spruce beetle winter mortality resulting from record low temperatures in Arizona. Environ. Entomol. 3(5):752–4.

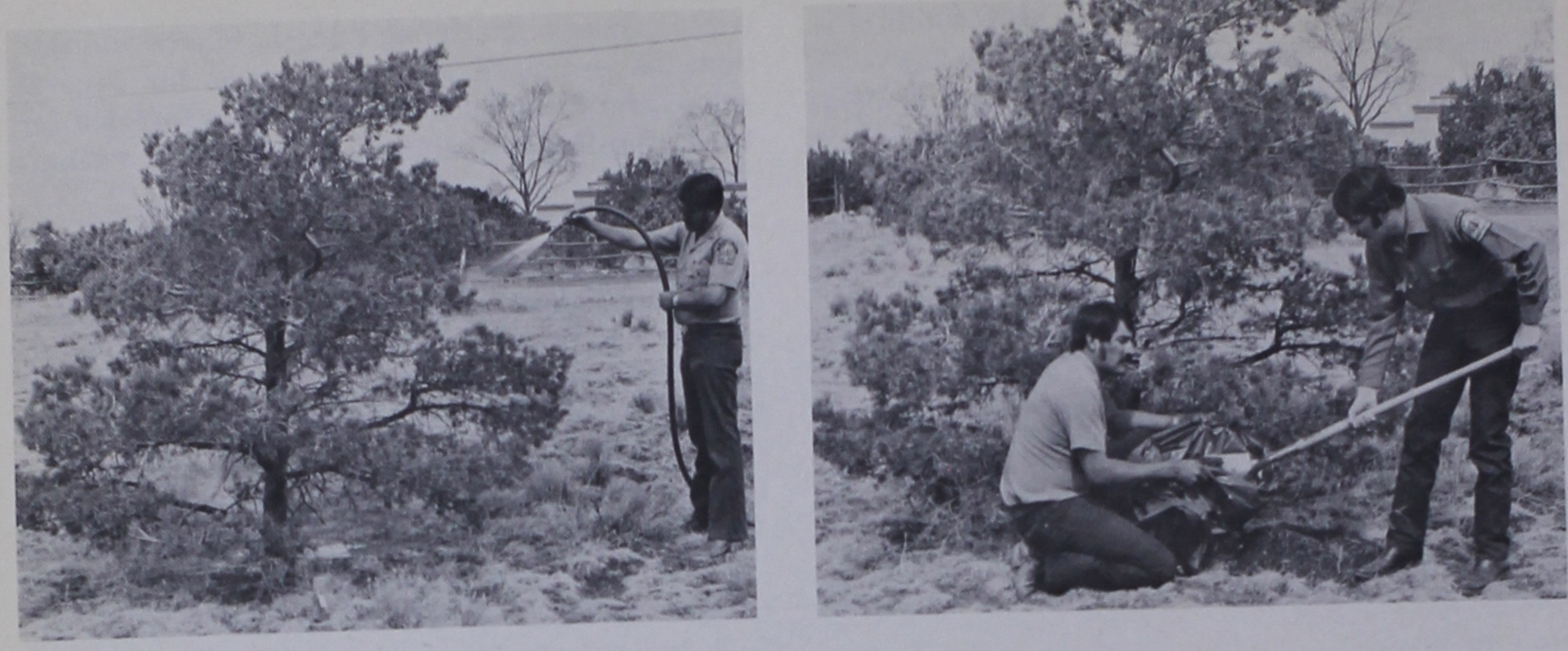

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Figure 18.—Cultural control method for pinyon needle scale, *Matsucoccus acalyptus* Herb.: *Left*, washing eggs from pinyon branches and trunk with garden hose; *right*, bagging dislodged egg masses and litter for disposal.

Western tent caterpillar, *Malacosoma californicum* (Pack.). Populations of this pest increased in the aspen type on the Kaibab Plateau and Escudilla Mountain, Ariz., and the Black Range, Gila National Forest, N. Mex. Defoliation, although severe in some areas, was not expected to cause immediate mortality, because the trees appeared vigorous and refoliated quickly. The tent caterpillar populations on the aspen in northern New Mexico declined.

White fir needle miner, *Epinotia meritana* Hein. An outbreak of this insect continued for the third year on 10,000 acres of the Apache-Sitgreaves National Forest, northwest of Alpine, Ariz. Additional top-kill of white fir was observed on permanent study plots within the infested area.

Southwestern pine tip moth, *Rhyacionia neomexicana* (Dyar). This insect continued to damage reproduction-size ponderosa pines in regenerated burns on the Apache-Sitgreaves National Forest, Ariz. Studies are being conducted jointly by the Region and the Rocky Mountain Forest and Range Experiment Station to determine the damage being incurred by this insect.

Pinyon needle scale, *Matsucoccus acalyptus* Herb. This insect caused severe damage to trees in and around Prescott, Ariz., and Santa Fe, N. Mex. A cultural control method (fig. 18) developed by the Region and the Rocky Mountain Forest and Range Experiment Station received widespread acceptance in these two cities, where private homeowners desire an effective alternative to pesticides.

Other insects. A large infestation of aspen tortrix, *Choristoneura conflictana* (Wlk.), remained at a high level on the Kaibab National Forest, Ariz. A leaf-rolling gelechiid moth, *Compsolechia niveopulvella* (Chambers), caused noticeable aspen defoliation near Alpine, Ariz. Extensive defoliation of aspen occurred in northern New Mexico as a result of a late frost and an unknown leaf-rolling moth (fig. 19). The tiger moth, *Halisidota ingens* Hy Edws., continued to cause some scattered defoliation of ponderosa and pinyon pines throughout the Region.

Status of Diseases

Dwarf mistletoe, *Arceuthobium* spp. In the Southwest, dwarf misteltoe continued to be the most serious disease. *Arceuthobium vaginatum* subsp. cryptopodum (Engelm.) Hawks. and Wiers, which occurs on ponderosa and Apache pines, was the most important destructive disease of commercial forests in Arizona and New Mexico. In 1974, approximately 31,000 acres were treated. Prevention through silvicultural stand treatments will continue to be emphasized.

Figure 19.—Aspen defoliation by freezing temperatures and, to a lesser extent, by an unidentified leaf-roller. F–523638

Rusts. Limb rust, *Peridermium filamentosum* Pk., remained at low levels in ponderosa pine forests of the Southwest. Midcrown branch mortality caused by limb rust was frequently noted on the south rim of Grand Canyon National Park. Removal of rust-infected trees should maintain this disease at low levels. Spruce broom rust, Chrysomyxa arctostaphyli Diet., and fir broom rust, *Melampsorella caryophyllacearum* Schroet., continued to cause spiketops, bole deformation, and some mortality in several areas of the Region. Broom rust on white fir appears to be increasing on portions of the Cibola National Forest, and removal of substantial numbers of infected trees may be necessary to arrest deterioration.

Foliage diseases. Foliage diseases remained at low levels throughout the Region. *Elytroderma deformans* (Weir) Dark. was noted on several scattered trees along the south rim of Grand Canyon National Park. *Marssonina populi* (Lib.) Magn. caused minor defoliation of aspen in scattered areas of the Carson National Forest.

Weather damage. Examination of individual and scattered groups of ponderosa pine revealed several probable causes for their declining condition. The Region has experienced periods of drought for several years. Especially significant to tree vigor was the extremely low precipitation in many portions of the Region between July 1973 and July 1974. Drought stress, along with re-

duced vigor resulting from mistletoe parasitism concomitant with attacks from secondary insects, resulted in tree mortality.

Salt damage. Chloride toxicity was confirmed by foliage analysis of white fir on the Cibola National Forest, after white fir, Englemann spruce, and corkbark fir showed symptoms of chloride damage. The salt damage, which resulted from uptake of runoff waters from highways treated with deicing salts, occurred on roadside trees along highways maintained for winter recreation on the Cibola and Santa Fe National Forests. Alternative methods for treating these highways must be considered if salt damage is to be reduced.

Aspen diseases. Aspen stands in the southern Rocky Mountains are heavily infected with stem rots and canker-causing organisms. The selective cutting of aspen has resulted in severe logging damage to residual trees, and consequently the trees may be more susceptible to infection by disease-causing microorganisms.

Air pollution. Areas near major sources of sulphur oxide, or which had suffered previous pollution damage, were examined for sulphur dioxide injury in Arizona and New Mexico. No obvious injury was found.

SOUTHERN AND SOUTHEASTERN STATES (R–8) [10]

by

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Conditions in Brief

The southern pine beetle continued to be the most damaging forest insect pest in the South. The current outbreak area included 53 million acres of commercial pine forest in 11 States, an increase of 6 million acres over 1973, with the greatest increases in Georgia, North Carolina, and Virginia. Beetle activity decreased somewhat in Alabama, Louisiana, and Mississippi. Throughout the Region, 147.7 million board feet of infested sawtimber and 44 million cubic feet of pulpwood were removed.

Ips beetle activity remained high in Arkansas and in Florida. The Florida Division of Forestry reported volume losses of 16.7 million cubic feet of pulpwood and sawtimber, attributed mostly to *Ips* spp. *Ips* activity increased locally in Mississippi and Texas.

Defoliator activity remained generally low throughout the South. The fall cankerworm caused defoliation in Virginia and North Carolina, and the forest tent caterpillar remained active in southern Louisiana and southern Alabama. There was a notable decline in the number of male gypsy moths trapped in 1974; only three moths were caught in North Carolina, and one each in South Carolina, Tennessee, and Kentucky. In Virginia, only 27 moths were trapped, compared to last year's catch of 750.

Aerial surveys revealed a dramatic increase in balsam woolly aphid-caused mortality in Fraser fir stands of the southern Appalachian mountains. Mt. Rogers in Virginia remained the only area with Fraser fir where the aphid had not been detected.

An important problem facing tree improvement programs are insects that affect pine seed production in Southern seed orchards. A continuing effort is being made to determine the impact of insects on seed and cone production. In addition, promising control methods are being tested.

Air pollution may be affecting the forest and tree resources in many areas of the South. Examination showed that familiar pollutants such as sulfur dioxide and fluorides caused localized plant injury in Tennessee, Arkansas, and Alabama. Localized injury by other pollutants was noted in North Carolina, South Carolina, Louisiana, and Mississippi. In addition, sensitive white pines were thought to be affected by oxidant pollution in some urban and rural areas of Tennessee, North Carolina, and Virginia.

Oak wilt incidence remained low in the South. The known distribution included portions of Tennessee, Kentucky, North Carolina, South Carolina, Virginia, Texas, Arkansas, and Oklah ma. Oak wilt was found for the first time in Poinsett County, Ark.

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[10] Includes forested lands in Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

Cylindrocladium root rot and black root rot continued to cause losses in several southern nurseries. Damping-off fungi caused little loss except on container-grown pine seedlings at the Stuart Project in Louisiana.

Status of Insects

Southern pine beetle, *Dendroctonus frontalis* Zimm. This species of bark beetle continued to be the primary pest in the Region. Table 2 summarizes the reports of the several State agencies and the Forest Insect and Disease Management staff. Figure 20 shows the gross area of southern pine beetle infestation in 1974.

In Alabama, most infestations appeared to be located in the Piedmont and northwest sections of the State. Beetle activity increased somewhat in Arkansas. The Florida Division of Forestry described southern pine beetle activity in the Alaqua Creek area of Eglin Air Force Base as the worst outbreak in 25 years. Surveys by the Georgia Forestry Commission showed populations increasing in the mountains, the lower Piedmont, and the upper Coastal Plain, and declining in the central Piedmont. The Georgia Forestry Commission chemically treated more than 61,000 trees between June and November 1974.

Beetle activity was reported to be greatest in central Louisiana, but increasing in the northern regions. The Kisatchie National Forest is located in the center of an outbreak area where population levels remained moderate or decreased slightly. Localized areas such as the Vernon District, however, experienced increased activity.

In Mississippi, southern pine beetle activity remained predominantly in the southwest portion of the State. Population levels on the Homochitto National Forest continued to decline since the initial outbreak in 1970. Levels remained at less than two infested trees per 1,000 acres of host type throughout 1974. In the northeast portion of the State, beetle activity appeared to be spreading. Increased infestation levels are expected in 1975.

The current southern pine beetle outbreak in North Carolina was described as the most severe outbreak in 15 years. The North Carolina Division of Forest Resources estimated that beetle activity across the State doubled in 1974. The situation at the end of 1974 was severe across the State, except in the southcentral Piedmont, where the outbreak was considered static. Both State and Federal forest managers carried out aggressive suppression programs to remove infested trees.

Table 2.—Summary of southern pine beetle infestations, 1974

State	Number of counties infested		Number of acres infested	Harvested	
	1973	1974	acres infested	Sawlogs (MBF)	Pulpwood (MCF)
Alabama	53	49	10.3	15,086	6,530
Arkansas	4	4	0.9	446	103
Florida	NA	NA	205–305	NA	NA
Georgia	59	79	7.8	31,282	13,099
				3,937 NF	315 NF
Louisiana	31	22	5.6	2,855	162
Mississippi	17	14	2.3	3,279	225
North Carolina	64	81	8.3	41,833	6,431
				2,459 NF	705 NF
South Carolina	22	28	5.3	5,000	10,000
				3,120 NF	377 NF
Tennessee	NA	13	0.9	1,296	130
Texas	22	26	8.4	23,346	1,068
Virginia	NA	42	2.8	11,326	4,090
				2,500 NF	729 NF

NA = *not available*
MBF = *thousand board feet*
MCF = *thousand cubic feet*
NF = *National Forest*

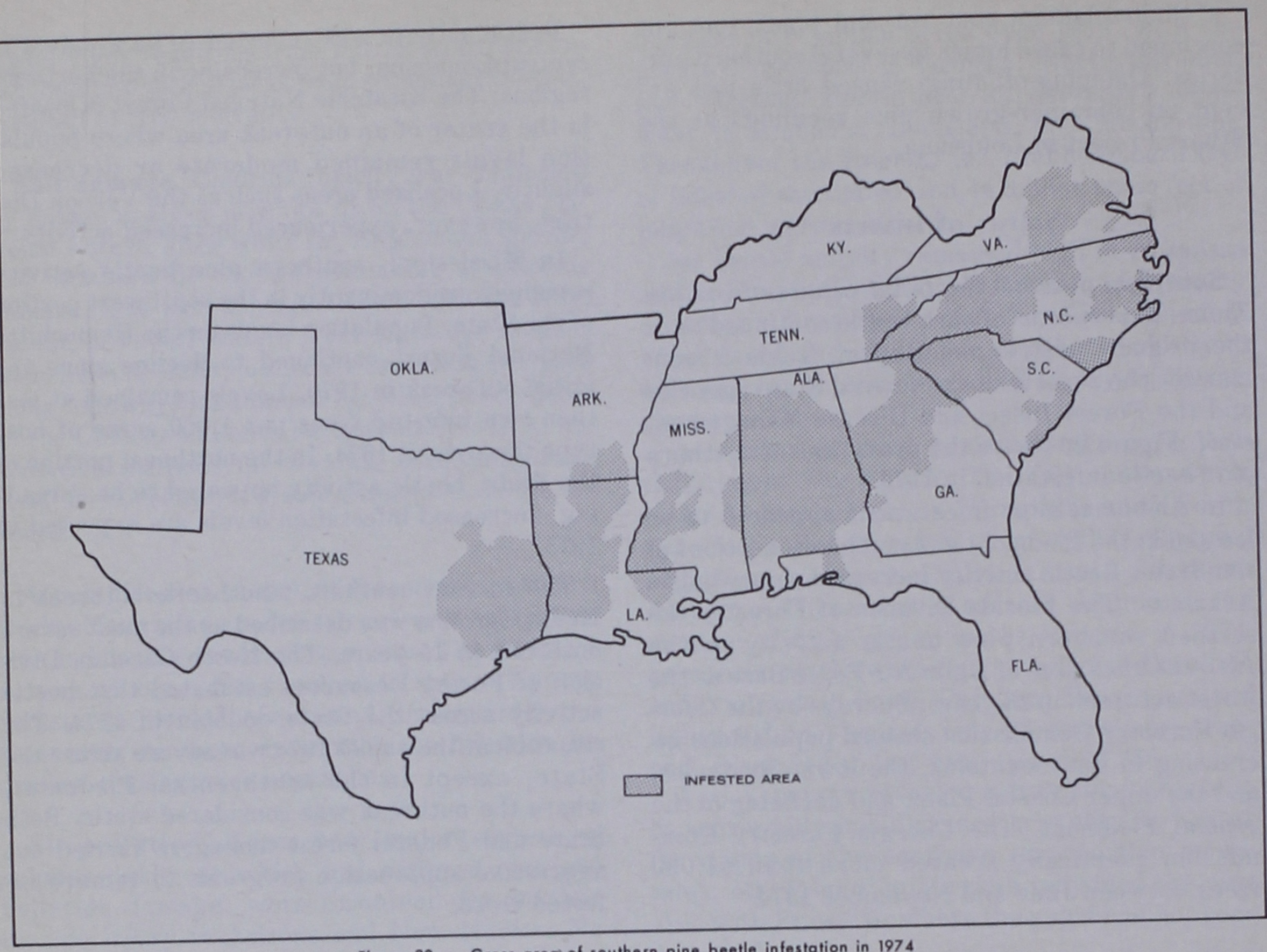

Figure 20. - - Gross area of southern pine beetle infestation in 1974

Although the outbreak increased in South Carolina in the last year, its intensity lessened in some areas. The severity of the outbreak varied across the State, with the worst problem occurring in the coastal counties. During fiscal year 1974, the South Carolina State Commission of Forestry waged an aggressive suppression program.

In east Tennessee, much of the outbreak occurred on the inaccessible mountain ridges of the Cherokee National Forest and the Great Smoky Mountains National Park. Infestations left to "run their course" have killed several thousand trees. Insect infestation increased on the Cherokee National Forest in 1974 and is expected to increase again in 1975.

In Texas, 1974 southern pine beetle populations were reported to be 15 percent higher than those of 1973 and are expected to remain at about this same level in 1975. Activity was heaviest in the western half of the outbreak area, but continued to spread to the northern and northwestern portions of the area.

The outbreak in Virginia increased in area and severity. The Virginia Division of Forestry reported an increase in beetle activity in all counties, especially in those in the southern edge of the outbreak area. The State reduced timber losses through an intensive suppression program, but this suppression effort was hampered somewhat by the inaccessibility of infested trees. The outbreak is expected to continue in 1975.

***Ips* engraver beetles,** *Ips* spp. *Ips* activity remained relatively high in Arkansas, especially in the northern and northwestern regions and in the Arkansas River Valley. Increased activity was reported in localized areas in Texas, particularly around logging sites. A high incidence of lightning-struck trees in central and southeastern Mississippi resulted in moderate *Ips* beetle activity. The Florida Division of Forestry annual

Figure 21.—Black turpentine beetles attack the lower bole of pine trees, causing massive pitch tubes.

survey showed 4 percent less tree mortality in 1974 than in 1973. Volume losses, which were mostly attributable to *Ips* spp., were reported to be approximately 16,700 thousand cubic feet of sawtimber and pulpwood.

Black turpentine beetle, *Dendroctonus terebrans* (Oliver). Populations in Texas, Alabama, Louisiana, Arkansas, and Mississippi remained static, with some localized buildups around logging sites and in lightning-struck trees. An infestation of black turpentine beetle (fig. 21) was reported in the Juniper Springs Recreation Area on the Ocala National Forest.

Nantucket pine tip moth, *Rhyacionia frustrana* Comstock. Satisfactory control of the Nantucket pine tip moth was achieved on young trees in the Beech Creek Seed Orchard during 1974 with one application of phorate (Thimet 10G®) early in the spring. The tip moth population on the Francis Marion Seed Orchard was held in check with periodic applications of dimethoate in the shortleaf pine orchard. Taller trees that were left untreated in the loblolly and longleaf pine orchards had a relatively high infestation rate in September. In the longleaf pine orchards, a tip moth tentatively identified as *Rhyacionia subtropica* Miller was found infesting an average of 20.5 percent (a range of 14 percent to 27 percent) of the five uppermost buds.

The Nantucket pine tip moth also continued to be a problem on shortleaf and loblolly pines at the Ouachita, Erambert, and Stuart Federal Seed Orchards in Arkansas, Mississippi, and Louisiana, respectively. Each orchard used dimethoate in control programs.

Coneworm, *Dioryctria* sp. Attacks on second-year cones by coneworms remained at approximately the 1973 level. During the year, the 14 orchards participating in a Regionwide test suffered an average loss of 13.7 percent. In 1974, losses on six loblolly pine orchards and three slash pine orchards averaged 14.6 and 4.7 percent, respectively.

On the Ouachita Orchard, coneworm damage to second-year shortleaf cones decreased from 40 percent last year to less than 1 percent this year. Damage to first-year conelets was 1.4 percent this year.

Seed bugs, *Leptoglossus corculus* (Sax) and *Tetrya bipunctata* (H&S). Seed bugs apparently have caused a serious loss of seed in second-year Virginia pine and shortleaf pine on the Beech Creek Seed Orchard near Murphy, N.C.

Cone moth, *Eucosma tocullionana* Heinrich. The population of the cone moth in the Edwards State Seed Orchard, Morganton, N.C., was at its lowest level since 1971, as indicated by the number of infested second-year cones in the Virginia pine orchard. Two applications of 0.125 percent dimethoate on April 26 and May 13 reduced the damage by 65 percent in treated portions of the Orchard.

Pine needle midge, *Contarinia* sp. An undetermined species of needle midge caused defoliation in loblolly pines at the Erambert Orchard in Mississippi for the fourth straight year. Damage appeared to be worse this year than it has been for the past 3 years. Apparent differences in susceptibility to needle midge attack were noted on some cones.

Fall cankerworm, *Alsophila pometaria* (Harr.). Three separate outbreaks of fall canker-

worm occurred on the Wayah Ranger District of the Nantahala National Forest in western North Carolina during May and June of 1974. One infestation of the Coweeta Hydrological Laboratory began increasing in intensity in 1972 and 1973. In 1974, the egg parasite, *Telenomus alsophilae* Vierick, reduced this population so that only light to moderate defoliation was detected during an aerial survey in June. The two other infestations detected in late May 1974 occurred west of Franklin, N.C. Approximately 500 acres were defoliated near Wayah Bald, and 1,000 acres were defoliated east of Wayah Gap. These infestations are in remote areas and should not require suppression measures.

The Virginia Division of Forestry also reported outbreaks of fall cankerworm. There were 4,000 acres of infestation in the Bull Run Mountains of northern Virginia, 2,700 acres 40 miles west of Bull Run in Clarke County, 400 acres at the north end of Skyline Drive, and 500 acres on the eastern shore near Eastville, Va.

Balsam woolly aphid, *Adelges piceae* (Ratz). Aerial surveys conducted this year showed a dramatic increase in aphid-caused tree mortality in Fraser fir stands of the southern Appalachian Mountains. New infestations were detected on the Tennessee-North Carolina State line in the Great Smoky Mountains National Park near Newfound Gap; along the Blue Ridge Parkway between Mount Pisgah and Waynesville, N.C.; and on Roan Mountain, N.C. Mount Rogers in Virginia remains the only area of Fraser fir where the aphid has not been detected. During 1974, suppression activities were conducted on the Mount Mitchell State Park and the Toecane Ranger District of the Pisgah National Forest.

Gypsy moth, *Lymantria dispar* L. Two gypsy moth eradication projects were conducted for ARS-APHIS in this Region this spring. An infestation on the University of North Carolina campus in Chapel Hill was treated three times with carbaryl to suppress an incipient population detected during the 1973 trapping program. In Virginia, a 1,000-acre area in the Hungry Mother State Park was treated.

There was a notable decline in the number of male moths trapped in 1974. Only three moths were caught in North Carolina, and one each in South Carolina, Tennessee and Kentucky. In Virginia, 6,000 traps caught only 27 moths as compared to last year's catch of 750.

Forest tent caterpillar, *Malacosoma disstria* Hubner. About 500,000 acres of water tupelo in Southern Louisiana and 58,000 acres in southern Alabama were partially to completely defoliated by this insect during the 1974 season.

Loblolly pine sawfly, *Neodiprion taedae linearis* (Ross). Near Tallos, La., only 50 acres of loblolly pine were lightly defoliated this year, compared to 1,000 acres in this same area last year. The extensive defoliation in Arkansas and Mississippi reported last year did not occur this year.

Sluglike sawfly, *Caliroa* sp. A sluglike sawfly infested red and white oaks on 335,000 acres of forests in southern and southcentral Kentucky during the last summer. Defoliation was scattered throughout the area and was heavy in some areas. No tree mortality was reported.

Status of Diseases

Cylindrocladium root rot, *Cylindrocladium scoparium* Morg. Until recently, Cylindrocladium root rot was primarily associated with nursery tree seedlings (fig. 22). Recent reports, however, implicate the disease as a possible threat to field plantings. During the spring of 1974, *C. scoparium* was isolated from symptomatic roots collected from a natural sweetgum stand near Athens, Ga. Trees in this stand averaged 14 inches d.b.h. and 70 feet height. This is apparently the first report of this disease occurrence in a natural sweetgum stand. Prior to this, Ross (1967) had isolated *C. scoparium* from symptomatic and damaged trees in a 27-year-old yellow poplar plantation in the vicinity of the diseased natural sweetgum stand in Georgia.

Blackroot rot, *Sclerotium bataticola* Taub. (Davis) and *Fusarium oxysporum* Schlect, and **Southern blight,** *Sclerotium rolfsii* Sacc. Black root rot is thought to have caused the mortality of 1.5 million loblolly pine seedlings at the Walker State Nursery at Reidsville, Ga. Southern blight at the Page State Nursery, also near Reidsville, prevented the establishment of approximately 1 million bicolor lespedeza seedlings, which were to be outplanted as a wildlife food plant. Black root rot can be prevented by fumigating with a formulation of methyl bromide consisting of 98 percent methyl bromide and 2 percent chloropicrin, sealed in a polyethylene tarpaulin.

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Figure 22.—Cylindrocladium root rot symptoms on: *Left*, 1–0 yellow popular seedling; *right*, 1–0 black walnut seedlings.

Damping-off, *Fusarium* sp. Damping-off of container-grown southern pine seedlings continued to be a problem at the Stuart Project in Louisiana. Serious losses to damping-off also occurred in other container projects in Texas and Louisiana. In inoculation studies, a Turban®-Benlate® fungicide treatment gave the best results for controlling disease development.

Juniper blight, *Phomopsis juniperovora*, Hahn. Nearly half of two red cedar beds at the Winona State Nursery in Mississippi had juniper blight, despite preventative spraying with benomyl. In Oklahoma, a nursery fungicide spray study showed that the disease increased in severity when the red cedar seedlings were sprayed with benomyl. The check plots sprayed with puritized agricultural spray were largely unaffecte .

White pine foliage disease, *Pestalotia sp.* A foliage disease apparently associated with *Pestalotia* sp. has been a serious problem in forest tree nurseries in the Carolinas. Altogether, approximately 1,040,000 white pine seedlings showed severe foliage symptoms. It is thought that extremely heavy rains from mid-July to mid-August favored the disease. Development of symptoms was observed following this rainy period. Chlorothalonil (Bravo®) applied once a month from May to October and more often during rainy periods should control this white pine foliage disease.

Oak wilt, *Ceratocystis fagacearum* (Bretz) Hunt. Oak wilt continued to remain at low levels throughout the Southeast. The known distribution included portions of Tennessee, Kentucky, North Carolina, South Carolina, Virginia, Texas, Arkansas, and Oklahoma. Oak wilt was found for the first time in Poinsett County, Ark.

Periodic surveys were conducted to determine if oak wilt had spread to new areas. In 1974, portions of Alabama, Mississippi, Louisiana, Texas, Oklahoma, Arkansas, Virginia, North Carolina, and Tennessee were surveyed. In all, only 15 trees were positively identified as having oak wilt. No known oak wilt control work was conducted in the Southern Area during fiscal year 1974.

White pine blister rust, *Cronartium ribicola* Fisch. Blister rust continued to cause damage and presented a threat to eastern white pine reforestation in high rust-hazard zones in the southern Appalachians. Rust-hazard zones were further delineated and generally found in the mountains of western Virginia and northwestern

North Carolina. Results obtained from 23 permanent disease evaluation plots located on the George Washington and Jefferson National Forests and Shenandoah National Park in Virginia showed increases in both rust infection and mortality in natural white pine stands between 1970 and 1974. Rust infection increased approximately 6 percent. Blister rust control projects were conducted on the Shenandoah National Park and George Washington National Forest in western Virginia and on private land in northwestern North Carolina during fiscal year 1974.

Pitch canker, *Fusarium lateritium f. pini* Hepting. Pitch canker caused terminal damage and occasional tree mortality in slash pine plantations throughout northern Florida. Aerial and ground surveys conducted by the Florida Department of Forestry revealed moderate damage on 180,000 acres of slash pine in Franklin, Volusia, and Flagler Counties. In most plantations, 35 to 40 percent of the trees were infected.

Weather damage. In the spring of 1974, many forested areas of the South were hit by devastating tornadoes. In Alabama, 70,000 acres were affected; in Kentucky, 12,000. There was also considerable damage in North and South Carolina. Forest Insect and Disease Management assisted States and National Forests in assessing the damage through aerial photography and ground examination.

Air pollution. In many areas of the South, air pollution may be affecting forest and tree resources. Recent examination showed that familiar pollutants such as sulfur dioxide and fluorides had caused localized plant injury in Tennessee, Arkansas, and Alabama. Localized injury by other pollutants was noted in North Carolina, South Carolina, Louisiana, and Mississippi. Obvious symptoms have usually been limited to within 5 to 10 miles of large point sources.

Sensitive white pines in some urban and rural areas of North Carolina, Tennessee, and Virginia have shown foliage symptoms, decline, and mortality because of oxidant pollution. Furthermore, recent air monitoring studies found unexpectedly high levels of ozone in some rural areas.

Other diseases. A disease of uncertain cause continued to cause dieback and mortality in sycamore plantations in Louisiana and Mississippi. A survey conducted in 1974 indicated that incidence of the dieback was greatest in Louisiana. Mortality in plantations surveyed in Louisiana was less than 5 percent. The 1974 survey was a cooperative effort among Forest Insect and Disease Management of State and Private Forestry, the Southern Forest Experiment Station, and the respective States.

A survey of cottonwood plantations in the Mississippi River Delta of Arkansas, Louisiana, and Mississippi failed to reveal any serious widespread disease problems. A canker disease caused by *Fusarium so ani* (Mart.) App. and Wr. em. Snyd. and Hans. was observed on several plantations. Leaf spot diseases were also prevalent. This survey was a cooperative effort among the Forest Insect and Disease Management Staff, State and Private Forestry, the Southern Forest Experiment Station, and the respective States.

The coal fungus, *Ustulina vulgaris* Tul., caused extensive root and butt rot of sugarberry (*Celtis laerigata*) in residential areas of New Orleans, La., resulting in costly removal and cleanup operations by the City.

The eastern mistletoe, *Phoradendron sertinum* (Raf.) M.C. Johnst., caused a serious decline of oak and elm at several locations in Vicksburg National Military Park, Miss. Control by pruning mistletoe-infected branches was carried out at some important locations in the Park in 1974.

Leaf scorch, heavy defoliation, and some mortality were observed in hardwoods in east Texas, Oklahoma, and northwestern Arkansas. The overall area coincided with the eastern limits of the drought area of the Great Plains that occurred during the early summer of 1974. Drought symptoms were most noticeable on post oak, but other oaks as well as hickories and dogwood were commonly affected. Very little mortality occurred, and damage was mostly confined to dry sites.

NORTHERN STATES (R–9) [11]

by

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Conditions in Brief

The gypsy moth continued its spread through Pennsylvania and threatened to become established in lower Michigan. In 1974, 750,905 acres were defoliated, of which 190,000 acres were aerially sprayed in the cooperative State-Federal program. The spruce budworm infested 124,000,000 acres in Northeastern North America. In Maine, which had over 5,000,000 acres defoliated, about 430,000 acres were treated with Zectran®. Egg mass and damage surveys indicated an increase in budworm population, and an area of 3,500,000 acres may need treatment in 1975. The outbreak in Minnesota subsided, but in Wisconsin and Michigan, outbreaks increased. The oak leaf roller continued to spread and cause heavy defoliation in parts of Pennsylvania; the cherry scallop shell moth continued to defoliate black cherry in Pennsylvania; and damaging populations of hemlock looper were present in Pennsylvania. A total of 13,400 acres were sprayed with carbaryl, trichlorfon, and Orthene® in an effort to control this defoliation. Moderate to heavy larch sawfly populations were present in New York and New Jersey. Malathion was used in Vermont to protect grafted larch plantings.

Tree diseases were static throughout the Northeast. Dutch elm disease continued to spread throughout timber stands in Wisconsin and Minnesota and increased in intensity in New York. Oak wilt appeared to be static in all States. Beech bark disease caused mortality in beech stands in Pennsylvania, New York, New Hampshire, and Maine. Lophodermium needle cast was prevalent in many Scotch pine plantations. Many of the plantations in the Lake States, New York, and New England were treated with maneb or Daconil®. Red pine shoot blight was reported in new areas of Minnesota and Wisconsin. Scleroderris canker appeared to be static in the Lake States. Anthracnose was present in nearly all States of the Northeastern Area, but caused little damage in forest stands. White pine blister rust was still a mortality factor in some white pine areas. A limited amount of control work was being done by States with large quantities of white pine. Hypoxylon canker continued to kill aspen in the Lake States. Ash dieback increased in parts of New York. Air pollution continued to be a problem in West Virginia and Pennsylvania, and spring frosts caused extensive freezing injury in a portion of Illinois.

Status of Insects

Gypsy moth, *Lymantria dispar* (L.). Pennsylvania was again the primary site of gypsy moth activity. Populations increased in the areas of eastern Centre County and portions of southeastern Pennsylvania. There was a dramatic collapse in the population over most of the Pocono Plateau. Moderate to heavy defoliation occurred on 479,590 acres, substantially less than the 856,710 acres defoliated in 1973.

A significant reduction occurred in the gypsy moth population in New England, New York, and New Jersey. Acreage defoliated by the gypsy moth decreased from 920,000 to 370,000 acres. Massachusetts and Maine were the only States that had a significant increase in defoliation—acres defoliated nearly doubled in these two States. Overall, the gypsy moth defoliated 750,905 acres in the Northeast in 1974, which is a 42-percent reduction from 1973.

In 1974, the States surrounding Pennsylvania continued to monitor the influx of gypsy moth by using the disparlure-baited (sex attractant) traps. New male moth catches were recorded in the following counties: Fayette and Morgan Counties, W. Va.; Geauga County, Ohio; and Green County, Mo.

Approximately 190,000 acres were treated in the cooperative State-Federal program. Three registered insecticides—carbaryl, trichlorfon, and *Bacillus thuringiensis* (a biological insecticide)—were used successfully. Disparlure in combination with carbaryl was applied over 750 acres in Pennsylvania under a cooperative agreement with Pennsylvania State University.

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[11] Includes forest lands in Connecticut, Delaware, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin.

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Figure 23.—Cherry scallop shell moth larvae feeding on black cherry.

Pennsylvania and West Virginia continued to rear and release gypsy moth parasites. Of the 603,703 parasites released by Pennsylvania, *Apanteles liparidis* Bouche comprised 38 percent of the total. Out of a total 44,750 parasites released in West Virginia, 35,350 were *Brachymeria intermedia. A. liparidis* Bouche; *Coccygominmus turionelle* (Linnaeus); *Meterous pulchricornis* (Wesmael); and *Palexorista* spp. were released in New York to increase the number of natural control agents in gypsy moth populations. New Jersey Department of Agriculture, in cooperation with APHIS, is mass rearing 11 new or exotic species of parasites. Maryland, which already had gypsy moth infestation, and Wisconsin, which was located outside the gypsy moth infestation, also reported release of parasites.

In general, the gypsy moth infestation is expected to spread to the south and west of the currently infested area in Pennsylvania.

Oak leaf roller, *Archips semiferanus* (Walker). Pennsylvania has been plagued by this insect since 1967. In the years from 1967–73, the oak leaf roller defoliated 3.5 million acres of forest land. Mortality losses from 1970–72 were 2,438 million board feet on 900,000 acres sampled. This year, 140,000 acres were heavily defoliated with 90,000 acres of light to moderate defoliation. The Allegheny National Forest reported 63,000 acres of light to heavy defoliation by the oak leaf roller; moderate defoliation was also reported in four counties in lower Michigan.

Cherry scallop shell moth, *Hydria prunivorata* (Ferguson). This insect (fig. 23) continued to defoliate black cherry throughout northwestern Pennsylvania. In 1974, the State reported 16,000 acres with heavy defoliation and 186,000 acres with light to moderate defoliation. This is the fourth consecutive year that the Allegheny National Forest reported severe defoliation. Feeding by the cherry scallop shell moth also is responsible for chokecherry and wild cherry mortality in western Michigan.

Fall and spring cankerworms, *Alsophila pometaria* (Harris) and *Paleacrita vernata* (Peck). Population levels were as high in 1974 as in 1973 in Rhode Island. New York reported that fall and spring c nkerworm larvae contributed to the defoliation in infested gypsy moth areas. Increased defoliation occurred in three counties in New Jersey. Approximately 4,000 acres were sprayed with Sevin®-4-oil to control an outbreak of these insects in Massachusetts. Pennsylvania reported that the fall cankerworm caused 3,000 acres of heavy defoliation and 4,100 acres of moderate defoliation in 1974. West Virginia had 3,200 acres of heavy defoliation in Jefferson and Grant Counties. When *P. vernata* and *A. pometaria* caused defoliation on the south side of Minneapolis, Minn., a 40-block area was treated with *Bacillus thuringiensis* by helicopter; a single application appeared effective.

Eastern tent caterpillar, *Malacosoma americanum* (Fabricius). The eastern tent caterpillar caused heavy defoliation in many areas of New York. Light to moderate defoliation was reported on wild cherry and other forest and shade trees in New Hampshire.

Redhumped oakworm, *Symmerista canicosta* (Franclemont), and **orangehumped mapleworm,** *Symmerista leucitys* (Franclemont). Noticeable feeding by these two defoliators was observed on

sugar maple, oak, and many other shade trees in Maine, Vermont, New Hampshire, and New York. Orangehumped mapleworm infestations were found on sugar bushes at St. Regis Falls and Tug Hill, N.Y. The redhumped oakworm is collapsing throughout the northeast. Low population levels of the oakworm were reported in Connecticut, Iowa, Michigan, and Rhode Island.

Aspen blotchminer, *Lithocolletis tremuloidiella* (Braun). This insect, along with unidentified miners, caused moderate to severe defoliation on approximately 25,000 acres of aspen and balsam poplar in the town of Peru, Clinton County, N.Y. Moderate defoliation also occurred in other areas of Clinton and Essex Counties, N.Y.

Birch leafminer, *Fenusa Pussilla* (Lepeletier). Moderate to severe browning of birch was caused by these miners in New Hampshire, Maine, and Vermont. Defoliation was statewide in Vermont, with the second generation causing more damage than the first generation. These insects also caused birch defoliation in central and northern Wisconsin.

Spruce budworm, *Choristoneura fumiferana* (Clemens). In 1974, total acreage defoliated by the spruce budworm in Northeastern America was estimated at 90 to 100 million acres, probably a record for acreage defoliation by this insect. An estimated 124 million acres had been infested by the insect.

The acreage defoliated by spruce budworm in northern Maine covered in excess of 5 million acres, in 1974, and involves the fir-spruce type in five counties: Aroostook, Penobscot, Piscataquis, Somerset, and Washington. The infested area represents a twofold increase over 1973.

In June, a cooperative State-private-Federal suppression project was conducted on 430,000 acres of infested timber in Maine. Zectran® was applied aerially at the rate of 0.15 lb. a.i. per acre, and results indicated a 95-percent reduction in the budworm population in the treated areas. Because of the tremendous increase in the size of the infested area and the intensity of feeding, an area of 3.5 million acres may need treatment in 1975.

In the Lake States, the spruce budworm outbreak in northeastern Minnesota declined, but outbreaks were increasing in northern Wisconsin and Michigan. Tree mortality was reported from all three Lake States. Minnesota treated 3,500 acres with Zectran® at the rate of 0.15 lb. a.i. per acre; larval populations were reduced approximately 90 percent in treated areas.

Western Pennsylvania reported 13,000 acres of heavy hemlock defoliation by the spruce budworm in Cameron, Elk, and Clearfield Counties, Ohio, and Indiana reported a large number of moths in northern areas.

Jack pine budworm, *Christoneura pinus* Freeman. The jack pine budworm defoliated 500,000 acres in the northern half of lower Michigan, and mortality of over 50 percent was reported on about 20,000 acres in the vicinity of Oscoda. Dying trees will be harvested in the near future. Some defoliation is expected to continue in 1975, and jack pine budworm buildup is reported from northwestern Wisconsin. About 12,000 acres were defoliated this year, and 50,000 acres of defoliation are predicted for 1975.

Hemlock looper, *Lambdina fiscellaria* (Guenee). Pennsylvania treated a total of 13,440 acres in five western counties to control this defoliator. In the past 5 years, severe defoliation occurred on 12,000 acres, resulting in the death of 500,000 trees. Ohio reported scattered light to heavy defoliation by this insect in eastern river counties.

Larch sawfly, *Pristiphora erichsonii* (Hartig). Moderate to heavy infestations of larch sawfly were reported in New York and New Jersey. Nearly all larch stands in northern New Jersey sustained 30 to 60 percent defoliation. Population levels were generally lower in Vermont and New Hampshire. Grafted larch plantings in Vermont were sprayed with malathion to minimize tree damage. A survey conducted in New York indicated that defoliation on Japanese larch was light to moderate. Larch defoliation in the Lake States was sporatic. In Minnesota, two parasites, *Olesicampe benefactor* and *Mesoleius tenthredinis,* were introduced a few years ago and appear to be established.

Pine looper, *Lambdina athasaria pellucidaria* (Grote and Robinson). Larval populations continued to cause light to moderate defoliation on pitch pine in Cape Cod, Mass., but population levels were considerably lower in 1974. Aerial

spray operations conducted in 1973 and natural controls probably contributed to population decline. Population trends indicate a collapse in 1975.

White pine cone beetle, *Conopthorus coniperda* (Schwarts). This beetle has affected eastern white pine seed production in Ohio for several years. Populations were high in Maumie, Mohican, and Zaleski State Forests. Seed yield for 1974 was at its lowest level, and the State is planning an insecticide pilot control study for next year.

Red pine scale, *Matsucoccus resinosae* (Bean and Godwin). The red pine scale caused heavy mortality of red and Japanese black pine in Suffolk, Nassau, Putnam, and Westchester Counties, N.Y. In portions of Bergen and Passaic Counties, N.J., 17 new scale infestations, totaling 23 acres, were detected. Of the 17 acres infested on Wanaque Reservoir, N.J., 14 were harvested for pulpwood.

European pine sawfly, *Neodiprion sertifer* (Geoffroy). Larvae were commonly found on Scotch and Austrian pines in two counties in New Jersey. In New York, population levels statewide continued slowly downward for the second consecutive year since the peak.

Arborvitae leafminer, *Argyresthia thuiella* (Packard). Arborvitae leafminers caused severe browning of arborvitae foliage in two New Hampshire counties. In Vermont, arborvitae mortality caused by defoliation of this insect continued. The largest populations were located in the northern portions of the State where they appeared to be increasing. In lower Michigan, this insect caused browning over large lowland areas. Defoliation is estimated at 50 to 75 percent in the area.

Balsam woolly aphid, *Adelges piceae* (Ratzeberg). Aerial surveys indicated that balsam woolly aphid damage increased in Vermont in 1974, with approximately 20,000 acres showing fir mortality. Approximately 3 to 5 acres of fir are severely infested by this insect on the Green Mountain National Forest; this area may be treated in 1975 to prevent further tree mortality and subsequent salvage operations.

Elm leaf beetle, *Pyrrhalta luteola* (Muller). Missouri reported light defoliation by this insect for 1974; the trend for 1975, however, predicts moderate to heavy defoliation throughout the State. Pennsylvania and West Virginia reported moderate to heavy defoliation scattered throughout the southern sections of their States. Elm leaf beetles were common in southern Michigan and caused browning of elms, especially Chinese elms.

Other insects. Most of the outbreaks of the large aspen tortrix, *Choristoneura conflictana* (Walker), have subsided; only Wisconsin reported scattered light defoliation. Locust leafminer, *Xenochalepus dorsalis* (Thunberg), caused heavy defoliation in the southern sections of Ohio and Indiana; Ohio reported the highest population level in the past 5 years. Whitemarked tussock moth, *Hemerocampa leucostigma* (J.E. Smith), caused light to heavy defoliation in several Indiana counties. Larval populations of the satin moth, *Stilpnotia salicis* (Linnaeus), are building up in areas defoliated in 1969 and 1970 in Maine. The oak skeletonizer, *Bucculatrix ainsliella* Murtfeldt, caused light defoliation on 100,000 acres of Tigo County, Pa.

The elm lace bug, *Corythucha ulmi* Osborn and Drake, caused browning of elm on about 5,000 acres in central Wisconsin. Tree damage caused by the sugar maple borer, *Glycobius speciosus* (Say), is still of major concern in discoloration and grade loss of sugar maple lumber production in Vermont. An aerial survey on the White Mountain National Forest in 1974 showed that over 90 acres of the pure beech stand were severely infested with oystershell scale, *Lepidosaphes ulmi* (Linnaeus), and salvage work is now being conducted in this area. The periodical cicada, *Magicicada septendecim* (Linnaeus), caused severe oviposition damage to oak and many other trees in Plymouth and Cape Cod, Mass.; approximately 30 percent of the terminal portions of many trees were amaged.

The pine tussock moth, *Dasychira plagiata* (Walker), appeared to be building up in northern Wisconsin, but no defoliation was reported this year.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor. This disease caused heavy damage and mortality to elms in several Indiana counties. In Missouri, it continued to be responsible for the death of many elms, and is at a very high level in New York. Dying elms are becoming a common scene in northern Wisconsin and eastern Minnesota, in addition to the ravaged southern parts of the Lake States. Wisconsin reports millions of board feet of high-quality elm lost to the disease. Most Regions are directing hardwood cutting into elm areas infected with Dutch elm disease.

Oak wilt, *Ceratocystis fagacearum* (Bretz) Hunt. Oak wilt was responsible for moderate damage in the northwestern part of Indiana and light damage over the remainder of the State. In Missouri, oak wilt occurred in the Salem area and in Randolph County on the Rudolph Bennett Wildlife Area. An oak wilt survey in West Virginia included 2,081 trees that year, which is about 25 percent fewer trees than in 1973. Dying oaks are common around the Minneapolis-St. Paul area in Minnesota, and in central Wisconsin. Michigan reported a lower incidence of the disease this year, but new discoveries were made in the western part of the Lower Peninsula of Michigan where the disease had not been previously reported.

Red pine shoot blight, *Sirococcus strobilinus* (Pruess). New areas were reported in northern Minnesota and Wisconsin where red pine regeneration under older red pines is being killed by the shoot blight. Because of the disease, artificial reforestation may be necessary in order to insure future stocking of red pine in some locations.

Scleroderris canker, *Scleroderris lagerbergii* Gremmen. The disease was present in all Lake States, but appeared to be static. Lower Michigan reported a new find about 30 miles south of the previously known infection center. Four new infection centers were found in a red pine plantation in the town of Diana, Lewis County, N.Y.

Anthracnose, species of *Gnomonia, Gloeosporium, Marssonina,* and others. Anthracnose was not as severe in most areas as in 1973. Throughout Indiana, sycamore was heavily defoliated, and twig dieback occurred during the spring and early summer (fig. 24). Maple, oak, and black walnut were also infected, but not as severely as sycamore. Missouri reported light to moderate damage by anthracnose. Sycamores were heavily defoliated in Maryland, with some dieback occurring following defoliation. Sycamore anthracnose was less severe in New England, New York, and New Jersey in 1974 than in 1973, while oak and maple anthracnoses were more severe. In southern Wisconsin, oak anthracnose was heavy on white and burr oaks.

Lophodermium needlecast, *Lophodermium pinastri* (Schrad. ex Hook) Chev. Lophodermium needlecast continued to plague owners in Scotch pine Christmas tree plantations in the Northeast. Heavily infected plantations were found in New York and Pennsylvania. In Indiana, Scotch pine Christmas tree plantations throughout the State suffered heavy damage from Lophodermium needlecast.

White pine blister rust, *Cronartium ribicola* Fisch. White pine blister rust infections were present at low levels in Vermont and Maine. Low

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Figure 24.—Anthracnose on sycamore.

to moderate infections continued in the northern portions of Minnesota, Wisconsin, and Michigan.

Beech bark disease. Beech bark disease is caused by a combination of a scale insect, *Cryptoccoccus fagi* (Baer.) Dougl., and a fungus, *Nectria coccinea* var. *faginata* Loh., Wats. & Ay. The complex of insect and fungus is well established in eight counties of northern Pennsylvania, where mortality has been reported in two areas. The two beech scales, *C. fagi* and *Xylococculus betulae* (Perg.) Morrison, were observed in advance of the *Nectria* component (fig. 25) in three additional counties. Beech scale is now prevalent in most beech stands in New York. The infestation is moving westward, with more mortality occurring in older, infected beech stands. The killing front is east of the Hudson River, but is moving steadily westward. Vermont reports that approximately 1 million acres of forest land containing beech were affected by this disease. Infested and dying beech stands were prevalent in New Hampshire and Maine. The most important factor in checking the development and spread of the infestation is a winter temperature of -35 F. or lower, which causes high mortality of the scale.

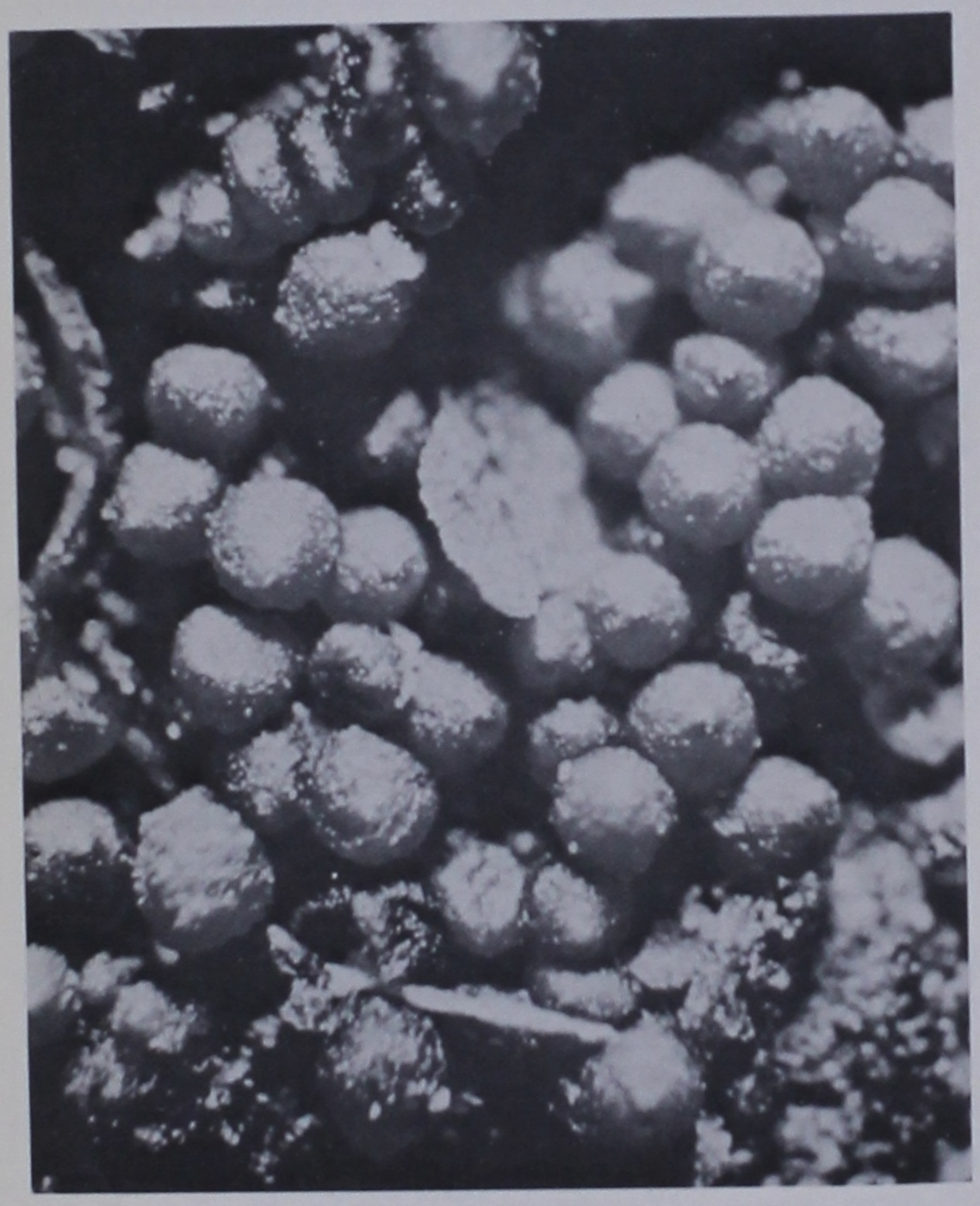

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Figure 25.—Perithecia of *Nectria coccinea* var. *faginata*, one causal agent of the beech bark disease.

Diplodia tip blight, *Diplodia* spp. This disease has affected Austrian pine throughout Pennsylvania. Mortality was observed on soil 8 inches or less in depth to a clay subsoil. Apparently shallow soil depth and seasonal high water levels are predisposing factors for dieback and mortality. New York reported diplodia tip blight at a high level and increasing in severity.

Annosus root rot, *Fomes annosus* (Fr.) Cke. *Fomes annosus* activity was at a low or static level throughout the Region, although new infection centers were found at Alder Creek and Watson, N.Y. Annosus root rot was also present in most pine plantations on State forest lands in Ohio.

Canker of Russian and autumn olives, cause unknown. The seed stock at Painted Post Nursery, N.Y., was in a state of decline, and some mortality resulted from this disease. The infected nursery stock may be a hazard to Russian olive and autumn olive used for wildlife and ornamental purposes.

Air pollution. Tip burn and chlorosis, thought to be caused by ozone, were observed on the white pines in the area extending from Clearfield County to Bradford County, Pa. An examination of white pine in this area revealed less air pollution damage than in 1973. An air pollution problem in the eastern part of West Virginia appeared to be part of a general syndrome in the Allegheny Mountain range. Trees in plots established in 1971 continued to decline.

Weather damage. Late spring frosts were responsible for the circular- and oval-shaped holes in the leaves of oak species throughout Pennsylvania; the holes were caused by frost damage to leaves in the bud stage or in early budbreak. Spring frosts caused varying amounts of damage in scattered locations in West Virginia. Extensive freezing injury occurred in the southern half of Illinois in spring 1974. Particularly hard hit were hemlock and Russian olive, and several species of ash, juniper, pine, and yew. Jack pine on about 30,000 acres in central Wisconsin suffered ice damage. A large volume of pine timber was blown down in southern Maine, west of Lewistown, during a July storm. In southern Michigan, leaf scorch of hardwoods along highways occurred, apparently caused by dry and hot weather.

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Figure 26.—Canker of white pine caused by *Verticicladiella procera*.

Salt damage. The general decline in susceptible tree species such as hemlock, red maple, sugar maple, and yellow birch in and around heavily used State Park road areas in West Virginia may be due to the heavy applications of salt used for deicing the roads. Salt damage was also evident on ornamental trees in Pennsylvania.

Other diseases. In Indiana, pine needle rust, *Coleosporium* spp., caused light damage to pines in eight counties; in Pennsylvania, it was reported on 10 percent of the trees on a 3-acre red pine plantation. Slightly higher levels of gummosis were observed on black cherry in Cambria and Indiana Counties, Pa. Shoot blight and leaf spot, *Venturia* spp., were prevalent in young aspen in the Lake States. Ash leaf rust, *Puccinia spargancoides* Ell. & Barth, has been severe along the northeastern coast during the last 3 years; although it was less severe last year, dieback and top kill still resulted. White pine root decline, *Verticicladiella procera* Kend., caused severe losses in several West Virginia Christmas ree plantations, and was also very common throughout Ohio, killing eastern white pine (fig. 26) on public and private land. Ash dieback was reported on the increase throughout the Finger Lakes Region and Hudson River Valley in New York, following several years of static infection. Armillaria root rot, *Armillaria mellea* Vahl ex Fr., caused pine mortality in scattered locations throughout the Lake States, with mortality heaviest on plantations released from hardwood overstory. Brown spot needlecast, *Scirrhia acicola* (Dearn.) Sigg., is increasing in west-central Wisconsin, and also caused damage to Christmas tree plantations in Indiana.

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